WIRE & WIRE PRODUCTS

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

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EQUIPMENT
(*Continuous or Single Hole*)

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THE VAUGHN
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January 1933

FIRTH-STERLING
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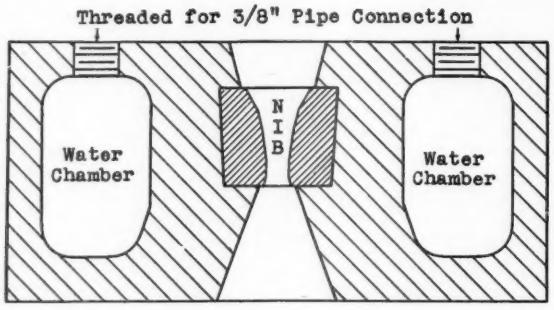
QUALITY



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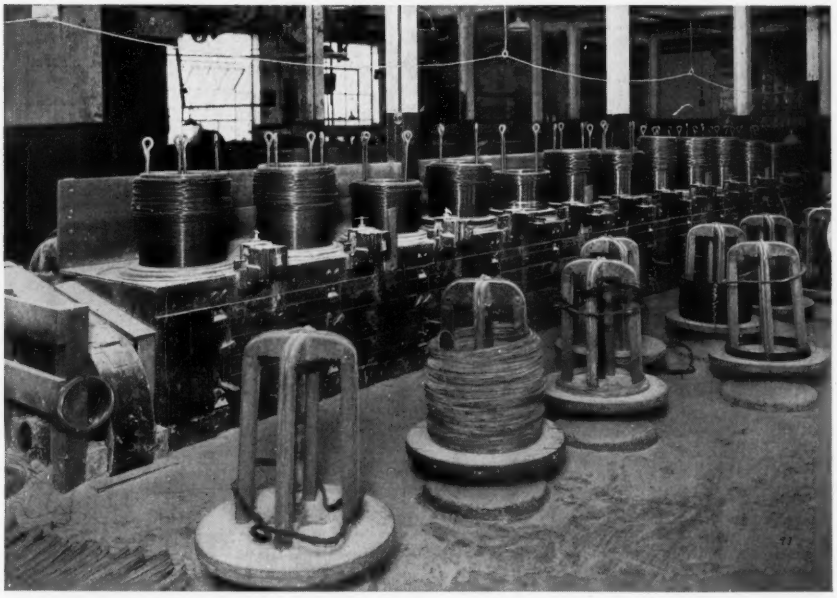

The illustration shows a typical installation of one of our machines in the plant of The Thompson Wire Co., Worcester, Mass. It is equipped with 12 heads. The first three are 16″ in diameter. The next four are 16″ double-decked blocks, while the last five finishing blocks are 12″ in diameter. The photograph was taken after this machine had completed its first three months of operation, seven days a week, 24 hours a day without the need for even a temporary shutdown for minor adjustment.

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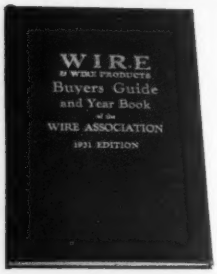

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WIRE & WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip. Wire Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING.

Vol. 8 January 1933 No. 1

Designated as

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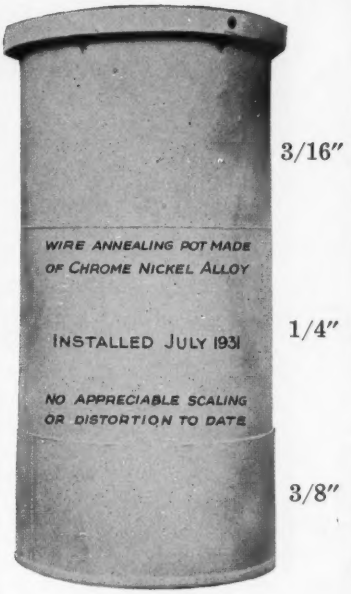

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WIRE & WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 8 JANUARY, 1933 No. 1

Copper Rod Rolling Mill of Eugene F. Phillips Electrical Works, Ltd.

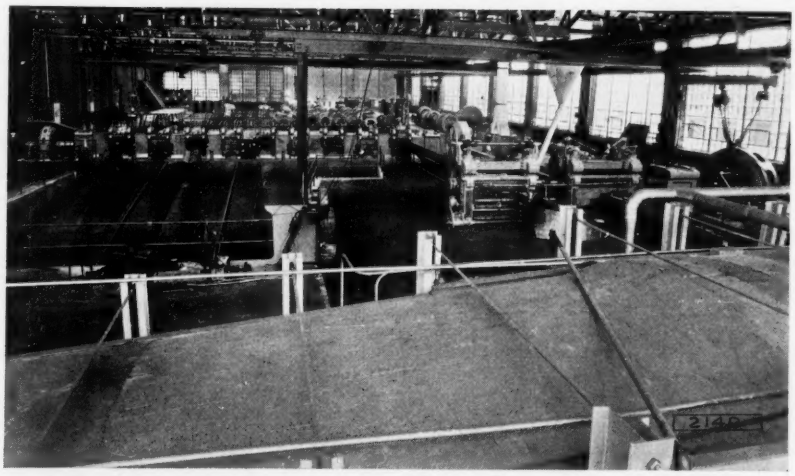
By R. C. Lewis, Division Engineer
Farrel-Birmingham Company, Inc., Ansonia, Conn

The New Mill at Brockville, Ontario, Canada, Built by the Dominion Engineering Works, Ltd., was Designed by and Erected Under the Supervision of Farrel-Birmingham Company, Inc. In Laying Out This Mill the Aim of the Designer was to Turn Out a Mill which would Roll a Diversified Product of High Quality at Low Cost.

TO roll a wide range of sizes and sections and still maintain low productive costs meant that everything affected by a change from one size or section to another must be designed so that the change could be made in a minimum of time. Parts that must be removed when a change in section is made are designed to be quickly and easily removed. Parts which must be moved and realigned are made with provision for ease, speed and accuracy in alignment. Parts that are used for some sections and not for others have been made to remain in place even when not used, wherever this is possible without interfering with the rolling of other sections.

✦ ✦ ✦

LOW productive cost meant a small operating force, low power costs and little scrap. To reduce the number of men necessary to operate this mill, automatic handling equipment was applied wherever practicable without endangering quality and increasing the possibility of scrap. Maximum power saving is obtained by the use of anti-friction bearings throughout the mill and accessory equipment. Maintenance of this power saving is assured through the sturdiness of the mills themselves and the adequate provision made for keeping the mills in the best possible operating shape.



General view of mill from top of furnace. ✦ ✦ ✦ ✦ ✦ ✦

✦ ✦ ✦

Capacity

THE nominal capacity of the mill, 30,000 pounds per hour, is based on the production of ¼"

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diameter rod. In addition to ¼" diameter rod, the mill is arranged to roll rounds up to and including 1-½" in diameter, squares corresponding to each size of round, and rectangular sections from 1-¼"x ¼" up to and including 4-¼"x1", from standard wire bars. The capacity when rolling the larger diameters, and flat bars, varies, depending on the number of passes taken, the points at which the finished size is taken from the mill, and the final delivery speed up to the limit of the furnace capacity. The billet heating furnace has a nominal capacity of 120 bars and an overload capacity of 180 bars of 250 pounds each per unit.

✦ ✦ ✦

Furnace Unit

WIRE bars are delivered from storage space and piled within the operating radius of a gib crane, by an overhead traveling crane. The gib crane is equipped with a 3000 pound "Lo-Hed" electric hoist, floor operated, and is used only for loading the furnace pusher. The furnace is oil fired and of the continuous type, 9'-10" wide x 44 ft. long. Two rotary fuel oil pumps, having a capacity of 600 gallons per hour at 20 pounds pressure, and a Spencer blower of 2000 cu. ft. per minute at 16 oz. pressure, feed eight Ryan, Scully & Company low pressure type burners. Automatic temperature control is obtained through a Leeds & Northrup automatic temperature recording pyrometer and Ryan, Scully & Company oil and air control valves, solenoid operated.

✦ ✦ ✦

THE hydraulic pusher, operated by a Hele-Shaw variable delivery pump, drives the bars through the furnace along rails of heat resisting alloy. Discharge from the furnace is at the end by gravity.

FURNACE equipment was furnished by the Railway & Power Engineering Corporation of Toronto, to Ryan, Scully & Company designs.

✦ ✦ ✦

Breakdown Unit

THE bars are delivered from the furnace at approximately 1650° F. onto a roller table. This table, formed of rollers, is driven by a reversing motor and serves as a sorting table and to deliver bars to the manipulating tables at the breakdown mill. Cold or otherwise unsuitable bars are discharged onto the floor at the furnace end of the table. Satisfactory billets pass through an air operated device for turning the bar, if necessary, to the correct position for entering the mill. A stop gate is provided to hold the bars, when necessary, for the breakdown mill.

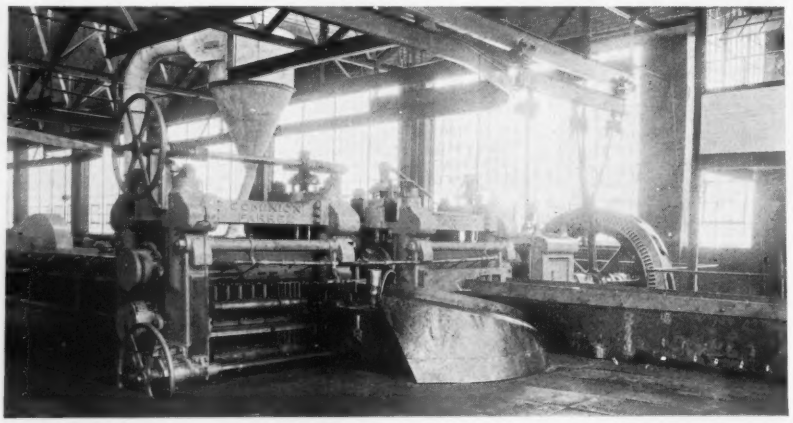
The breakdown unit is made up of two 20"x60" three-high mills driven by a synchronous motor, direct connected to a common pinion stand.

✦ ✦ ✦

THE two mills are duplicates, except for the roll adjustment and, of course, roll grooving and guides. The first mill, or breakdown mill proper, is equipped with spanner wrench roll adjustment, while the second mill has hand wheel adjustment to facilitate the handling of rectangular sections.

✦ ✦ ✦

DEEP grooves for edging passes when running rectangular sections, necessitated a different type of roll than the standard chilled iron, dry sand combination usually used in the breakdown stands of copper rod mills. A special alloy cast iron appeared to be the best suited for this work and it was used.



Breaking down mills showing lift table in the raised position at first breakdown mill, repeater from the 6th to the 7th pass, and guides for flat rolling in the second breakdown mill. ✦ ✦

✦ ✦ ✦

THE roll journals are mounted in Timken roller bearings. The bearing chocks are of steel and provided with semi-metallic packing with clock spring steel adjusting bands and labyrinth seal to prevent loss of lubricant and entrance of water.

✦ ✦ ✦

THE guides are mounted on an exceptionally rigid support table. This table is secured to the mill frames and is provided with a slot parallel to the mills, into which tongues on the guides fit. This construction insures quick and accurate guide alignment.

✦ ✦ ✦

THE pinion stand is of the unit type construction, fully enclosed. The Farrel-Sykes cut double helical pinions are mounted in Timken roller bearings with bearing chocks similar in construction to those employed on the mills.

✦ ✦ ✦

THE spindles are of the universal coupling type to eliminate noise and to remove the possibility of end thrust from the spindles coming onto the anti-friction bearings. The wearing parts of the spindles are fully enclosed and can be packed with lubricant and yet are simple to dismantle.

✦ ✦ ✦

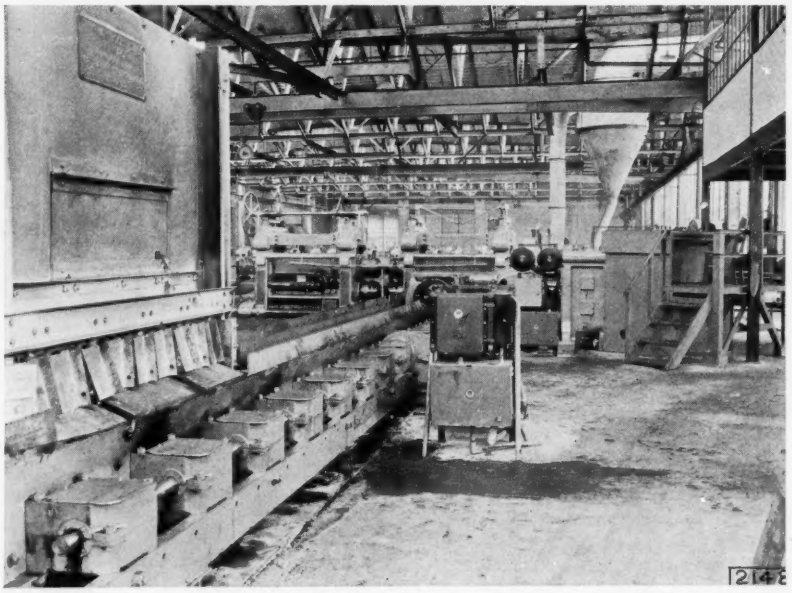
BARS from the table in front of the furnaces pass onto a lift table which feeds them into the first, third and fifth passes and receives them after the second and fourth passes.

The table is made of structural

steel, mounting eleven rollers. The rollers are mounted in SKF ball bearings and are driven through bevel gears by a reversing motor. The table is hinged at the back end and the front end is raised and lowered to register with the top and middle roll or the middle and lower roll by a crank motion.

A motor with suitable gearing, is used to raise and lower the table. To insure stopping in the exact position at top and bottom of the stroke, a one revolution clutch, solenoid operated, is used.

The table is arranged with fixed and movable guides to align the bar automatically for the proper pass. The movable guides are actuated by the raising and lowering of the table through linkage, so that they move the bar against the fixed guides which are aligned with correct grooves in rolls.



Showing location of pulpit in relation to the breaking down mills and roller table in front of furnace.

✦ ✦ ✦

IN back of the breakdown mill is another manipulating table which receives the bar from the first, third and fifth passes and automatically feeds it into passes two, four and six. This back table is made up of fixed position rollers, on which are mounted the parts for receiving and turning bars from passes one, three and five.

✦ ✦ ✦

AS the bars leave the rolls from the odd passes, they run out onto shelves of a suitable length for the bars at that particular pass. The bar while on this shelf is enclosed so that irregularity of shape or tendency to curve cannot cause the bar to fall. When the bar has completely cleared the rolls, it actuates a limit switch flag and the whole bar is lifted from the shelf and dropped onto the rolls of the fixed table.

✦ ✦ ✦

THE lifting and dropping of the bar is done by an air cylinder, controlled by the limit switch mentioned above, through a Bristol electrically operated pilot valve and diaphragm operated piston valve. The connections for these valves are also tied in with the lift table in front of the mill, so that the bar cannot be dropped unless the lift table is in the proper position to receive it as it is returned through the breakdown rolls. As the bar drops to the fixed table it is guided and turned 90°, so that it is in proper position to be returned to the mill rolls. The roller table rolls are constantly revolving, so that the bar is started into the mill as soon as it strikes the table. Vertical pinch rolls assist the horizontal rollers in starting the longer bars into the bite of the rolls.

✦ ✦ ✦

WHEN the bar leaves the sixth pass, it is carried to the seventh pass, which is in the second mill of the breakdown unit, by a semi-circular jump type repeater. This repeater is made adjustable through several sets of grooves in the two mills.

FROM the seventh pass the bar is carried to the intermediate train of rolls by a trough which automatically turns the bar 90° and enters it into the eighth pass. This trough is made of structural steel with cast iron plates for carrying the hot copper rod. To insure clearing the trough as the bar loops on entering the first mill of the intermediate train, a G. E. Thrustor pushes the bar clear as it enters the mill.

✦ ✦ ✦

Control Pulpit

THE control of the bar from the entering of the furnace until it enters the semi-circular repeater to the seventh pass, is in the hands of one operator located in the control pulpit. This pulpit is a raised platform from which the operator can see over the greater part of the mill. On it are located controls for the furnace pusher, the furnace table, the lift table in front of the breakdown mill, the table in back of the breakdown mill and controls for the main mill motors. Also lights are provided which indicate that finishing passes are filled so that the operator can regulate the breakdown operation to suit the rate at which the finishing train is functioning.

✦ ✦ ✦

Flat Rolling

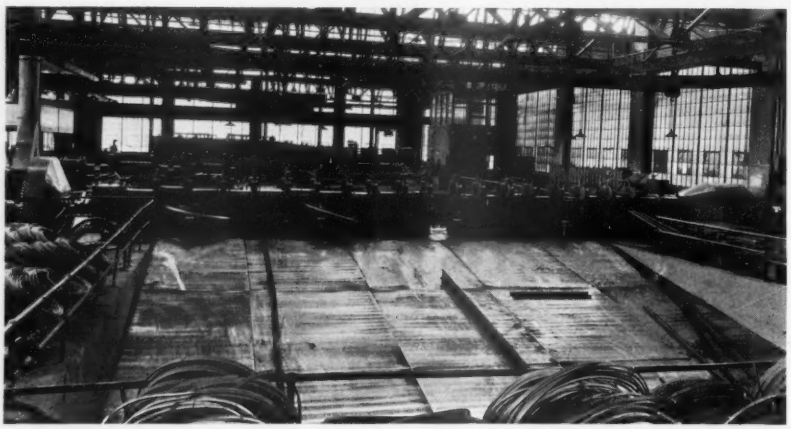
WHEN rectangular sections are being rolled, the semicircular repeater to pass number seven is not used. After pass number six the bar is handled by hand through edging and flat passes in the second breakdown mill. The grooves in the breakdown mill may or may not be the same as those used when operating to finish round rod, but the mani-

pulating equipment is used with the guides adjusted to the proper roll grooves. The flat stock is coiled on a floor coiler of the disappearing pin type in front of the mill. This floor coiler is of the same design as the coilers for the round rods, except that the rod coilers are of the lifting plate type rather than of the lowering pin type.

✦ ✦ ✦

Intermediate and Finishing Mills

THE intermediate and finishing trains are set up in one line of nine stands. The intermediate train is made up of five mills and the finishing train of four mills, each unit being driven by a synchronous motor direct connected to the pinion stand.



Intermediate and finishing trains, showing semi-circular jump type repeaters and leads to coilers.

✦ ✦ ✦

ALL mills are made as three-high mills, but mounting two rolls only. This keeps each mill a duplicate of all other mills, except for guides and roll grooving. These mills are of a construction similar to that used for the breakdown mill. Spanner wrench is used for adjusting the rolls. All rolls are Timken roller bearing mounted in steel chocks with the same type of lubricant and water protection used in the larger mills. Guides are supported on heavy tables provided with slots for alignment.

✦ ✦ ✦

THESE smaller mills, and the larger breakdown mills also, are fully enclosed with sheet metal casings for down draft dust exhaustion. The casings have adjustable openings for the guides. All bedplates are fully covered so that the suction from a Buffalo Forge Company double mill exhauster effectively draws all dust down into pits in the foundation. The foundation pits are connected by pipe to an exhaust head and dust collector located within the building proper.

With this down draft exhaust system all piping for dust exhaustion on and around the mills is eliminated.

✦ ✦ ✦

THE universal type of spindle and couplings used on the small mills are similar in design to those made for the larger mills. As each small mill is of three-high construction, but mounting only two rolls, top rolls of alternate mills and bottom rolls of alternate mills are connected by long spindles. These long spindles pass through dummy bearing chocks in the mill between the rolls being connected.

✦ ✦ ✦

AS stated above, the bar is delivered from the seventh pass in the breakdown mill unit and entered into the eighth pass, or first pass in the intermediate train, automatically. It is handled automatically from the eighth to ninth pass and from the tenth to the eleventh pass by semi-circular jump type repeaters. At all other passes the bar is caught, looped, and fed by hand.

Bollards and floor guides are provided to protect the workman at the mills and to keep the rods separate.

✦ ✦ ✦

ALL rods ⅝" in diameter and over are finished on the last stand of the finishing train. If the full number of passes are not required to reduce the rod to the size desired, passage of the rods through some of the mills in the intermediate and finishing trains is eliminated. To illustrate: Rod finishing ⅝" in diameter passes through the first mill of the intermediate train and is then taken to the next to the last mill of the finishing train, all stands in between not working on this particular size. Rods larger in diameter than ⅝" are taken from the particular mill in the finishing or intermediate train on which it is finished to the coilers.

Showing coilers, conveyor from coilers to cooling tank, and the control desk for coilers and conveyor.

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

Square sections are taken from

(*Please turn to page 25*)

Lubrication of Carboloy Dies

By J. R. Longwell

Carboloy Co., Detroit, Michigan

It is Believed that a Large Proportion of Wire Drawing Difficulties are Due to an Improper Knowledge of Lubrication. The Proper Lubrication of Carboloy Dies is Discussed Here and an Outline Given of the Difficulties in Drawing Due to Defective Rod and Wire. ▼▼▼

THE value of the coefficient of friction depends on the nature of the substances forming the two surfaces in contact, on the smoothness of these surfaces, and on the presence or absence of any lubricant, such as soap, oil, fat, graphite, or other substance between the surfaces. The frictional resistance per *unit area* varies directly as the pressure per unit area.

✦ ✦ ✦

WE are concerned, therefore, with four definite items in our study of die wear and the economical application of Carboloy dies in wire mills. These items are:

1—**The nature of the substances forming the two surfaces in contact.**
2—**The smoothness of these surfaces.**
3—**The presence or absence of any lubricant between the surfaces.**
4—**The pressure, per unit, between the surfaces.**

✦ ✦ ✦

The Die

CARBOLOY cemented carbide dies are made of tungsten carbide, tantalum carbide, or mixtures of the two cemented with a cobalt, nickel, or other suitable binder. The surface of the finished die, therefore, is made up of particles of carbide and binder. The technic used in manufacturing the materials and the die nibs is so simple and exact that the finished product can, for all practical purposes, be considered as free from variations which appreciably affect die wear.

✦ ✦ ✦

HARDNESS is not a true indication of the wear resisting quality of any surface. The nature and smoothness of the surface determines this point. Tests covering many die materials have determined the ones which we recommend and use in Carboloy dies.

✦ ✦ ✦

STARTING with a die material which experience has proved satisfactory, we are next required to prepare the surface of this material so that it is smooth and of a shape that will wear longest when in contact with the material being drawn. The smoothness and flatness of the surface determines the final results more than the accuracy of the shape, provided the shape is close to the one which experience has shown to be correct. A die maker with many years of experience in making chilled iron, steel, diamond and Carboloy dies, recently made the statement that dies with flat, smooth and concentric approach and bearing surfaces, would produce satisfactory and economical results even though the shape varied a great deal. He showed us a number of dies to prove this point, and there was certainly a wide difference in the die shape. The production records for the dies showed uniform figures. An examination of these die shapes bore out our experience in other mills on this point.

✦ ✦ ✦

WE have found that there is a die approach angle and bearing length combination that is best for every job. A short length of bearing usually requires a smaller, or tighter angle of approach than can be used with a longer bearing, if equal, or nearly equal production per hole is to be obtained.

✦ ✦ ✦

UNFORTUNATELY one can be easily led to believe that one has a good die by the high polish of the surface. High polish is desirable only when the surface is flat and smooth. The preparation of flat and smooth die durfaces requires the use of methods which can be accurately controlled. The use of hand work and wood laps is to be eliminated, and can be eliminated on dies .030 diameter and over, on dies smaller than .030, it is usually necessary to do some hand work, but even than, flat, smooth surfaces can be obtained if the right technic is followed.

✦ ✦ ✦

The Rod or Wire

THE nature of the substance forming the surfaces in contact and the smoothness of these surfaces determines the coefficient of friction between the two surfaces, and this has a great bearing on the ultimate die life. The utmost care and precision in finishing the surface of the die cannot offset the defects in the surface of the rod or wire which forms the second factor in the duet.

✦ ✦ ✦

Rod Defects

THERE are several surface defects common to rod which can be reduced, if not eliminated. Mill practice that turns out rod with the smoothest surface is most valuable in reducing the conversion cost of rod to finished wire. The defects commonly found in the

rods as they come to the wire mill, can often be traced back to the furnace charge, ingot casting methods, or rolling mill practice.

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Slivers

SLIVERS are always a source of trouble in the wire mill. Not only do these slivers cause direct trouble during the drawing operations, but they are one cause of the rod not being thoroughly cleaned. The abrasive oxides and sulphates which form under the slivers present a very poor drawing surface, and one which acts as an abrasive. We have installed Carboloy dies in mills where slivers made it almost impossible to use our dies, and yet the rod could be drawn through chilled iron dies with much less trouble. In these cases we were able to get away from some of our difficulties by making sure that the tail end of the bundle of rod was never used as the starting end for drawing. By using a wider, or larger angle of approach in the break-down die, and rounding or blending the approach into the bearing, we were able to iron out many of the slivers, but we have always found that slivered rod breaks up the surface of the rod, or wire, and presents so much abrasive and contaminating material that the dies are cut-out rapidly. No so-called lubricant can overcome the havoc wrought by slivered rod.

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Cracks

MILL operators seem to agree that the surface of all rod contains many minute cracks which are not visible to the naked eye, but which do affect the surface of the rod. These cracks cannot be fully cleaned of scale, and the sulphates which form during the acid dip. When the rod is drawn with a well prepared surface, we do find that the lubricating film smears over and into these cracks, and the detrimental effect is cut down to a large degree.

Overlaps and Overfills

OVERLAPS and overfills are caused by poor rolling mill practice. It may be that they can never be entirely eliminated, but it is possible to reduce them until they are minor defects. The edges of the overlaps and overfills are usually ragged and the scale and sulphates which form under these edges carry on into the dies and scratch the die surface. These defects also cause unequal loading of the dies and high pressure per unit area between the surfaces. This high pressure on small areas of the die surface, results in early die failure due to the breaking down of the lubricating film and in extreme cases the pressures set up are so great that they break down the cementing material on the die surface, and this allows particles of carbide to be pulled through the bearing. This breaking down of the lubricant and cementing material many times results in grooves being cut in the surfaces of the die. Even if grooves do not result, the failure of the lubricating film will cause the die to load, or gall, and the wire to scratch or break. Overlaps and overfills cause an unequal hardening of the surface of the wire, and at later drafts, this wire condition causes high unit loads on the die surface, and usually results in rapid die wear. This wear takes the shape of serrations or grooves in the die and scratched wire.

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Out of Round Rods

HOT rolled rods are seldom round. We have found that rods which are more than .010 out of round, greatly reduce the life of the dies. This condition has been found to affect the life of all dies when the starting rod is more than .010 out of round. One of the results noted in many cases, is the serration or grooving of the dies. This seems to indicate a tendency of the metal to crimp when it is rounded up in passing through the first die. This crimping action apparently causes unequal hardening around the circumference of the wire which creates lines of unequal loading in the subsequent dies. Invariably the last two dies in a four or five-hole operation will fail by wearing out of round. In many cases it has been observed that the finished wire was slightly out of round while the die through which the wire was drawn would still produce round wire when checked by drawing a piece of soft copper wire. This we think shows that the unequal strains set up in the wire due to the out-of-round rod, cause the wire to grow out of round after it leaves the die. Many times we have, in seven and nine die lines, found that a die, from two to five drafts ahead of the finisher has worn out of round and is causing the finished wire to grow out of round after leaving the finisher. If the die which has failed is not replaced with a round die, all the dies following it will fail by going out of round. These unequal strains set up in the wire certainly cause excessively localized pressures in the bearing area of the dies which break down the lubricating film and in the end tear particles of carbide from the die surface.

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WE have been able to reduce the effect of out-or-round wire in some cases by using a wider angle of approach in the die, which works the metal more rapidly. This rapid movement may cause the metal to flow more uniformly, and the heat generated during the drawing may be enough greater to effect some annealing. In order to form a good smooth surface on the wire, it is good practice to use a slightly longer bearing in the die with wide approach angle, and to blend the approach into the bearing. The formation of the ring in dies drawing out-of-round rod and wire is at a greater rate than with more nearly round wire or rod, and the rings are wider. This makes it necessary to give the dies more attention in order to keep the drawing surface smooth. The production per hole has in some cases been as much as 60% less with rod more

than .010 out of round than it was with rod less than .010 out of round.

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Scale

INCLUDING of scale and other substances which are cast or rolled into the billets or rod, are usually very abrasive and decrease the life of the dies. Abrasive inclusions such as the silicates which are present in steel made by the Bessemer process, are apt to prove particularly detrimental.

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Preparation of Rod for Drawing

GOOD rolling practice controls the smoothness of the rod delivered to the wire mill. It is now up to the wire mill to so prepare the surface of the rod delivered that it is free from contaminating substances which will break down the surface of the rod and the die.

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Good Lubricant Qualities

THE coefficient of friction and therefore, the power required to convert the rod into wire, is reduced by the presence of any lubricant between the surfaces during the drawing. Any lubricant to be of value, has sufficient body to keep the surfaces free from contact under maximum pressure, the lowest possible coefficient of friction, the greatest capacity for storing and carrying away heat, a high temperature of decomposition, power to resist oxidation or the action of the atmosphere, and freedom from corrosive action in the metal being drawn and the die.

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THERE are very few lubricants which will stand up under a pressure of more than 6000 pounds per square inch. The soap, grease, stearates, etc., which are commonly used in dry drawing break down and have little lubricating value at pressures as high as 6000 lbs. per square inch. The pressure between the wire and the die surfaces is at least as much as the elastic limit of the material being drawn and this is seldom less than 20,000 lbs. per square inch. It is, therefore, necessary to look further for the lubricant which separates the surfaces during drawing. There are several substances which are not generally classified as lubricants, but which have lubricating value. Graphite, certain iron oxides and hydroxides and metallic coatings are used. The use of graphite is limited today, but is worthy of greater use. The cleaning practice in the mills produces a surface of iron oxides and hydroxides called sull coat, on the rod, which is a lubricant. The amount of sull coat which is allowed to form on the surface of the rod, and its uniformity depend on the technic used in cleaning and rinsing, the period during which the rod or wire is allowed to remain in the atmosphere, the analysis of the water, the temperature, atmospheric conditions, etc. The usual practice is to vary the cleaning methods depending on whether the wire is to be drawn dry or wet.

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Dry Drawing

IF the wire is to be drawn dry, the rod is given a sull coat and a lime coat. The cleaning in sulphuric acid forms iron sulphate and free hydrogen. The surface of the rod may absorb some hydrogen which causes the surface to become "pebbly" and hard. This condition is called "acid-brittleness" and is very abrasive. Heating or baking the rod or wire drives off the hydrogen and leaves the surface with a good coating of soft oxide and lime. These two substances actually become the lubricant which forms the film between the metal and the die. They have sufficient body to withstand the pressures, have a lower coefficient of friction than the materials they separate, and have a high temperature of decomposition. The capacity of these substances to store and carry off heat is apparently not very good, but they have little if any corrosive action on the metals they separate. These materials are not free from the action of the atmosphere. They are most effective as lubricants when dry and if allowed to stand in the atmosphere for any great length of time, after baking, they absorb moisture. This moisture starts the rod to rusting and the rust so formed is very abrasive. The result is that the lubricating coating is loosened and peels off ahead of the die, leaving the abrasive oxides to carry through the die. The "so-called" lubricants which are placed in the die box serve to assist in spreading the coating over the rod as long as they are not moist. It must be remembered that the abrasive rust will also smear over the rod in the presence of these so-called lubricants, and that the appearance of the wire may not show much change over that made by the lubricating coating.

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IT has been found that new or old grease, when used alone, in the box of the ripping die, has a tendency to loosen the coating and to cause too light a coating on the wire after drawing to carry it through four additional drafts. The use of a mixture of lime and grease thoroughly mixed will produce a much better coating after the first hole and a coating which will carry through four more drafts. The use of from 40% to 60% by volume, dry lime, depending on mill and rod conditions, has been found best.

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Effect of Poor Cleaning

THE contaminating substances carried on the rod or wire after cleaning, ruin the coating, break down the lubricating film and cause excessive die wear, scratched wire and breaks. The small particles of silicon or silicates in Bessemer rod are not nearly so detrimental if the coating on the rod is of a quality to smear over the entire surface.

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Coating

THE quality of the coating seems to be controlled by the acid dip, washing, and atmospheric conditions, more than by the time the washed rod is allowed to stand in the atmosphere or on the sull rack. We have found some mills getting very good production per

hole when drawing Open Hearth or Bessemer stock, and yet they are not putting the rod on the sull rack at all. They simply allow the rod, which is hosed at a pressure of over 200 lbs. per square inch, to hang in the atmosphere for one minute before dipping in the lime tank. They use dry soap in the box ahead of the ripping die and draw four holes after ripping with no so-called lubricant in the die boxes. They use water-cooled die holders and guide the wire straight into the die.

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Poor Cleaning Affects Die Efficiency

MOST mill operators will tell you that the wire is made in the cleaning house and the first die. This is true. The cleaning house removes the abrasives and puts on a coating. The first die produces the lubricating surface on the wire. This requires that the die be of a shape which will produce the most uniform coating over the wire. Shape of the die has some little to do with this, but a flat, smooth approach which is concentric with the land or bearing is most necessary. If the die surface is not smooth, and the approach is not concentric with the bearing, the coating on the wire is not uniform, is thin, and spots may appear with no coating. The die angle best suited to each material, and coating in each mill, is easily determined. As a general rule, the angle of approach in the ripper die is from 2° to 4° larger than the angle found to be best in the line and finishing dies. For instance, in one mill we have found that a 16° angle of approach with a bearing length equal to one-half the diameter of the die will not produce more than 50% as much wire from the rod, within fixed limits, as can be obtained from a die with an approach angle of 22° and a bearing length equal to a full two-thirds of the die diameter after the approach has been blended into the bearing.

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IN this connection, it must be remembered, that some materials generally swell after leaving the die, while others suck down. The total bearing area made up of the sum of the area of contact in the approach and the area of the surface of the bearing, should be considered as in contact with the wire. The die for drawing wire which sucks, can usually have a longer bearing, and a wider angle than the die used in drawing material which swells. The angle of approach determines the pressure per unit area in the die. The larger the angle, the nearer the pressure comes to breaking down the lubricating film and the cementing material in the die surface. This is clearly seen in examining a die with a wide approach angle and long bearing, and comparing the surface of this die with the surface of a die made with a smaller approach angle and shorter bearing. The ring formed in the former is usually larger and forms faster due to the greater pressure per unit area in the die. The smaller the angle of approach for a given material being drawn, the longer the die life, provided the bearing length is the one best suited to the approach angle. One must bear in mind that the above refers to *drawing* from one size to a smaller size, and that the approach is considered as only reducing the wire.

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Guiding the Rod or Wire

IF the die is to be used for the additional purpose of guiding the rod or wire into the bearing area, we have another problem, and one which is found in most wire mills. Undoubtedly drawing the wire around corners into the die has a great deal to do with the formation of a uniform lubricating coating or film on the surface of the wire. We have found that the mills which arrange to guide the wire into the die as nearly on the axis of the die as possible, get much greater life from their dies. This is occasioned by not having the original coating thinned out by dragging over the edge of the die box and front relief of the die.

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Dragging the Wire

DRAGGING the wire over the front relief of the die and at the same time having the wire thrashing around and striking the front of the die, not only cuts down the uniformity of the lubricating film, but also adds an impact load to the die surface. This constant hammering of the die by the thrashing wire breaks down the coating and loosens particles of the carbide. This exposes a rough surface to strip the lubricant, and the carbide particles are drawn through the die, cutting it out. Die set-ups which most nearly eliminate this condition add greatly to the production per hole. In extreme cases where the dies are not properly serviced, this hammering action causes fast ring growth, and may break the nib. The die material is subject to notch effect, and the ring acts as a notch. In one mill, the elimination of this thrashing of the rod by using hard wood guides, more than doubled production per hole.

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Best Coating is Thin

THE cleaning house practice which will produce a satisfactory coating with a minimum of contaminating substances, is the one sought. Experience seems to teach us that the thinnest uniform coating which will not break down at any hole, is the best. We have noted the usual variations in cleaning house practice and the control of the acid bath, etc., and we only want to point out a few usual difficulties that caused a great deal of grief before they were overcome. In one mill, where it was apparently impossible to get good clean rods and uniform coating, it was found that the use of soft water corrected the condition. The water they had been using was so hard that after cleaning two yokes of rod, they could clean no more. The installation of a softening plant corrected this. In another mill, using water from a pond, the cleaning and coating was so bad on some days that they could not draw wire at all. The analysis of the water showed too much vegetable matter. Provision was made to make water analyses regularly, and to treat the water during periods when the

percent of vegetable matter was too high. A frequent error noted, is that of trying to clean bundles which are not loose enough to expose all strands to the action of the acid, and the rinse water. The hosing of the bundles, when done with water under a pressure less than 175 lbs, per square in., has in many cases been ineffective, and resulted in obtaining rod in the wire mill with no sull coat in many spots.

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ADDING so-called lubricants to the die boxes after the ripper, does not seem to improve the lubrication of the dies, and in many instances has proved to be a detriment. In several cases where the dies after the ripper were running hot, we found that the temperature of the dies decreased when the soap powder was removed. The use of soap powder at the ripper is quite common. We have noted no great difference in the results obtained with soap powder as against grease, when the soap was dry and free from lumps. We have found in several cases that finely powdered soap produced better results than granulated soap. The heavier the coating, the drier the so-called lubricant must be in the die box. In one case, we saw the average production; per hole doubled by changing from granulated to dry powdered soap in the ripper die box. In another mill drawing bessemer rod, we were advised that they had increased their production per hole very materially by adding up to 50% talc with the soap powder in the die box.

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THESE so-called lubricants which are added to the die box undoubtedly do assist in producing a good coating on the wire provided the right combination of cleaning room practice and die box lubricating mixture is used. The addition of die box lubricants to dies after the ripper, is of questionable value in dry drawing and must be determined in each case.

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Wet Drawing

WET drawn wire is wire which is drawn with a liquid supplied to the die as a lubricant. These liquids are made up of soap and water, soluble oils and water, etc., etc. Wet drawn steel wire in the fine sizes is usually given a metallic coating of copper, copper-tin, or tin-copper, and each coating gives a particular color to the finished wire which is required by the user of the wire. These metallic coatings serve as a lubricant to some extent. The coefficient of friction of these metallic coatings is not as low as that of the sull coat. Consequently the power required to draw wire wet is greater than that required for dry drawing and the die wear is greater. The so-called lubricants supplied to the die break down at pressures far below the pressure in the die, but the water does act as a film to carry the load, and some lubricant may come through on the wire. The cooling effect of the liquid is an advantage in the drawing process.

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Preparation of Wire

THE preparation of supply wire for wet drawing steel wire requires careful watching. Even traces of lime or dirt on the supply wire will cause the coating to be loose at each point where the dirt or lime is located on the wire, and this loose coating will usually cause some trouble in the drawing operation. Sulphuric acid will not remove the lime from the supply wire. In mills where considerable wet drawing is done, we have found two processes in use. In one, the wire is cleaned with sulphuric acid, washed, and placed out of doors to rust. After the wire has rusted, it is brought back, and is again cleaned in sulphuric acid, thoroughly washed, and stored in tubs submerged in water or liquor until time to coat. Unless the rusting and second cleaning is performed, it is usually found that there are spots of lime remaining from the dry drawn processes used in producing the supply wire. These lime spots in the wire are not removed by the sulphuric acid, but the rusting does loosen the lime, and when the wire is again cleaned to remove the rust, the lime falls off.

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THE second process is to use muriatic acid for cleaning the supply wire, since muriatic acid will remove all traces of lime from the wire. The wire is cleaned as usual, in muriatic acid, thoroughly washed, and stored in tubs submerged in water or liquor, until time to draw.

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IN both cases the wire is completely submerged either in water or liquor. Some mills state that the wire should be submerged in water or liquor for at least 10 hours before it is coated, and prepared for wet drawing. This allows the hydrogen to come off the steel and bubble up from the liquid, and we have seen bubbles broken under a lighted match and watched the hydrogen burn, so that we know that the hydrogen does come off during this period of storage.

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THE supply wire prepared as described above, is coated immediately before drawing by dipping the loose bundle in a solution of copper sulphate, or a copper-tin solution, or a tin copper solution. These solutions are always kept acid, and usually have some concentrated sulphuric acid added, so that the solution is definitely acid at all times. After the wire is thoroughly coated, it is rinsed in water, then in a soap solution and then drawn through the die. In most wet-drawing machines, the dies are submerged in the soap solution. We know of one mill which has the reputation for producing a very high grade of wet drawn wire, which has a uniform color, and in this mill the wire is taken from a soap tank, and again dipped in a solution of copper or copper tin, then submerged in a tub of rye meal liquor, and drawn from this tub through soap solution into the dies.

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Acid Action in Wire Drawing Solution

SINCE the rye-meal liquor solution is acid, and the coating

(*Please turn to page 26*)

The Construction and Manufacture of Wire Rope

By Percy R. Clark, Managing Director
Societatea Anonima Anglia, Ploesti, Roumania

A Detailed Synopsis of a Paper Read Before the Phoenix Technical Society of Roumania. Some of the Methods Described Herein Differ Radically from American Practices, and Engineers May Question Some of the Statements Made, Because of this. ▼ ▼ ▼ ▼ ▼ ▼

THE author opened his paper by drawing attention to the fact that it is not generally appreciated by users of wire rope that the wire rope is a most complicated and delicate piece of mechanism, and, like all machinery, does not lend itself in any significant degree to permanent standardization. The construction of the wire rope, like that of an internal combustion engine for instance, is in a continual state of flux; what was accepted as good practice yesterday, is today taboo.

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IT is an undoubted fact that the average user of wire rope has a sort of vague idea that a rope is a rope, and that is all there is to it —some being good and some bad. The author mentioned having on his files letters from customers in which they just ask for a rope so many metres long, without the slightest indication of construction or for what the rope is to be used.

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THE author then proceeded to explain in detail the gradual development of wire rope constructions and the raison d'etre therefor and then passed to the question of the lay.

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THE lay is the distance parallel to the axis of the strand in which a wire makes one complete turn about the axis of the strand, or the distance parallel to the axis of the rope in which a strand makes one complete turn about the axis of the rope.

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IT soon became realized that the length of this lay plays a very important role. Years of research and experiment have been devoted to this question. It was generally accepted that the length of lay should be in direct proportion to the diameter of the spiral. See Fig. 52.

This is a strand of 19 wires of 2 m/m. each; in other words a strand of a diameter of 5 wires thickness, as will be clearly seen from the design.

Hence the diameter of this strand will be 10 m/m. Presuming that the length of the outer layer wires is 100 m/m. then the length of the inner layer of wires should according to this rule by about 60 m/m. It was presumed therefrom that in this way each spiral wire would bear its fair share of resistance to tensile strain, and for many years this was roughly the principle adhered to.

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HOWEVER, as time passed and engineering feats became more and more gigantic, the demands on the wire rope became correspondingly more exacting. This was partly met by developments in the quality of steel wire. Wire drawers endeavored to create, and succeeded in creating, higher and higher breaking strains combined with more and more flexibility, and in general greater homogeniety. However, other phenomena arose which the improved quality in the wire alone did not meet. With the increasing depths of shafts in mines, the increasing depths of oil wells in the petroleum industry, ropes apart from their having to resist greater actual tension, were also called upon to resist extraordinary lateral pressures on the drums. Hundreds of ropes, which have been examined to ascertain the cause of failure, have shown that quite apart from exterior wear, quite apart from the breaking of wire from excessive flexing, the wires were destroying each other in the interior of the strands by cutting into one another. This is evident from the foregoing longitudinal section.

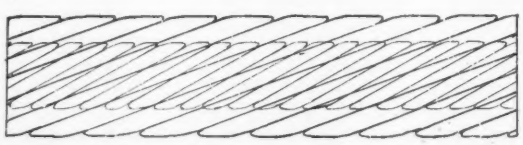

Fig. 52.

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IT was therefore eventually decided to experiment with ropes in which the two outer layers of the strands had the same length of lay, i. e. in which the lays of the outer and inner layers did not cut across one another. This is called line-contact in contadistinction to the old point-contact system.

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IN one respect this construction gives a big advantage. The length of the lay for different layers of wire being the same, the outer and inner wires are in contact with each other along their whole length and therefore the effect of lateral pressure, (i.e. crushing and mashing) is distri-

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Fig. 53.

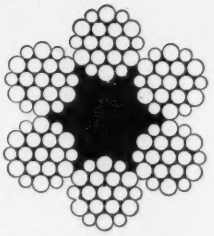

Fig. 54.

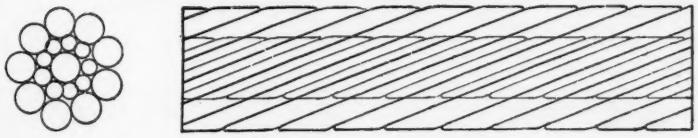

Fig. 55.

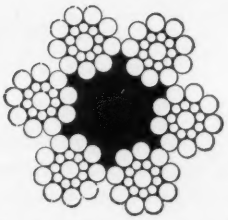

Fig. 56.

buted over the whole length of the wires instead of at the points where the outer wires cross the inner. Thus the wires of the inner and outer layers instead of nicking and eventually destroying one another tend under lateral pressure to weld into one mass.

It was thought at first that the system of line contact would reduce the tensile strength of the rope, but in practice there does not appear to be any appreciable difference.

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THERE are three main classes of line-contact ropes:

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ONE is the Warrington, which was formerly largely used in the petroleum industry in the States, both for drilling and bailing lines.

This is a 6x19 construction, but in this there are two thicknesses of wire in the outside layer. However, in the orthodox manner, there are 6 more wires in the outer layer than in the inner layer. The outer layer is made up of thick wires and thin wires alternately. The thick wires of the outer layer lie in the grooves between the inner wire, whilst the thin wires of the outer layer lie on the crowns of the inner wires, thus inter alia giving a smoother surface to the strand.

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ANOTHER type is the Seale construction which is favored very considerably for haulage purposes in the forestry industry in the States, and is now coming into favour very much for rotary drilling.

Under the Seale system there are equal numbers of wires in the outer and inner layers, so that each outer wire lies in a groove between two inner wires. In this rope are combined considerable flexibility and resistance to lateral pressure.

The Seale system lends itself to almost unlimited developments by increasing the number of wires in the two outer (line-contact) layers, as is illustrated by the sections shown below.

In fact in the case of a peculiar adaption of a percussion rig to rotary drilling, which was effected by the Foraky Romaneasca Company, it became necessary to construct a very flexible rope of 38 m/m. diameter, which was done by making a Seale rope of 6x85 construction (24+24+18+12+6+1).

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THE third, and most recent, development of line contact is the Filler contact. (See Fig. 62).

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In the ordinary round wire rope there are certain spaces left between the wires. Largely to combat crushing on the lower layers of rope on the drum, which obtains in drilling and certain other operations, fine wires (aptly called filler wires) were introduced into the interscices between the ordinary wires of the strand, still however maintaining point con-

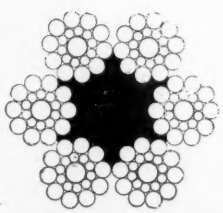


Fig. 57.

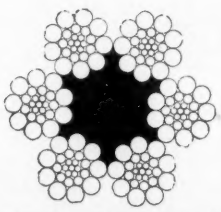


Fig. 58.

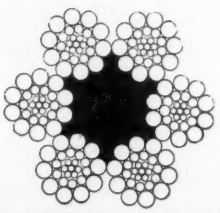


Fig. 59.

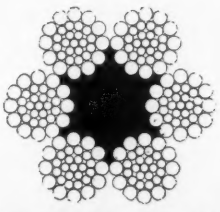


Fig. 60.

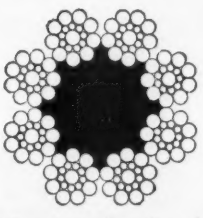


Fig. 61.

Save on Your

Winding Costs

With Winco PRODUCTS FOUR X Enameled Wire

▲ ▲ ▲ All wire meets the most exacting requirements ▲ ▲ ▲

Winco PRODUCTS 4X Enameled Wire has been developed to replace single silk covered and single silk over enameled wire in the winding of small motor armatures, fans, high frequency radio transformer coils and other apparatus where high insulation values and ability to resist abrasion, are prime factors.

▲ ▲ ▲

Winco PRODUCTS 4X Enameled Wire is covered to the same dimensions as the fabric covered wires, and can therefore be wound without changes in armature slots, bobbins or winding jigs.

▲ ▲ ▲

Is superior in its ability to withstand high temperatures.

▲ ▲ ▲

Will withstand softening in the varnish dipping and baking operations.

▲ ▲ ▲

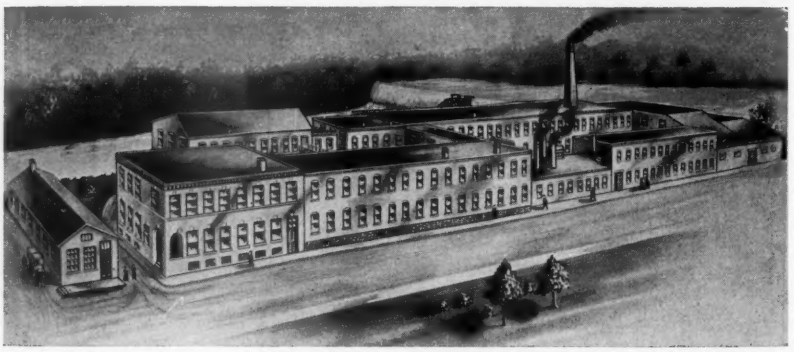
Requires little or no change in winding practice.

▲ ▲ ▲

Costs substantially less than the silk covered wire.

▲ ▲ ▲

Write for samples.



GENERAL VIEW OF PLANT, WINSTED, CONN. ▲ ▲ ▲

Products of leakage currents attack insulation and shorten the life of the coil. ▲ ▲

The only test indicating what the leakage loss in a winding may be is the test in mercury, which reveals the weak spots in the enamel covering. ▲ ▲ ▲

Our method of testing all wire by mercury test before shipment is calculated to give the user the highest degree of protection. ▲ ▲ ▲

ALL Winco PRODUCTS WIRE

GUARANTEED LEAK PROOF ▲ ▲ ▲

We would be pleased to quote on your requirements.

WINSTED INSULATED WIRE COMPANY

Incorporated

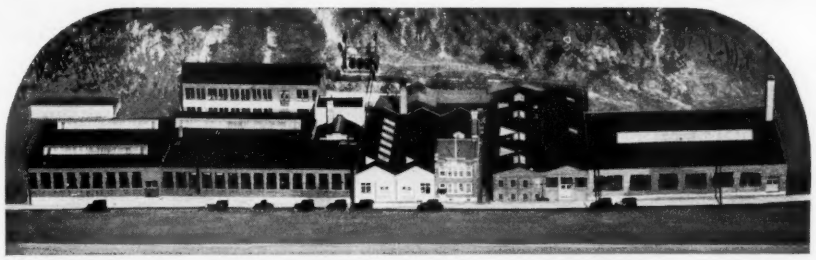
Winsted, Connecticut

"HUDCO" PRODUCTS...

Specially Processed Copper Wire...

For Enameling Purposes...

▲ ▲ ▲ Electrolytic and Oxygen Free ▲ ▲ ▲



AERIAL VIEW OF PLANT OF HUDSON WIRE CO., OSSINING, N. Y. ▲ ▲ ▲
▼ ▼ ▼ FINE WIRE MANUFACTURERS ▼ ▼ ▼

"HUDCO" High Conductivity Electric Wire

OTHER FINE BARE WIRES

High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Cadmium, 10%, 18% and 30% Nickel Silver, Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification.

BRUSH WIRES, CRIMP and STRAIGHT

Brass, Steel, Nickel Silver, Copper and Phosphor Bronze

TINSEL LAHNS

Silver Plated Copper, False Gold and Copper

METALLIC FIBRE FOR PACKING PURPOSES

Copper, Bronze, Zinc, Lead and Aluminum

WIRES FOR METAL SPRAYING

Zinc, Tin, Lead, Cadmium, Copper, Bronzes, Nickel Silver, Aluminum and other wires to specification.

ROLLED FLAT WIRE WITH ROUND EDGES

Copper, Brass, Nickel Silver, Zinc, Lead, Phosphor Bronze and other wires to specification.

"Hudco" copper wire is drawn by the Hudson Wire Company of Ossining, N. Y., who have been specialists in the manufacture of fine wires for over thirty years. ▲

The best grade of copper drawing stock is used, insuring the maximum conductivity. ▲ ▲ ▲

A new process of drawing and annealing is used which produces a wire unusually smooth, clean and uniform in color for enameling and other purposes. ▲ ▲ ▲

Painstaking care in the selection and maintenance of dies guarantees a product accurate to gauge and resistance. ▲ ▲ ▲

You can rely on "Hudco" wire always. ▲ ▲ ▲

Expert annealing of the wire prevents unnecessary breakage when winding the wire into coils. ▲ ▲ ▲

If you, too, have a specific problem demanding wire of exact requirements, write to us about it. ▲ ▲ ▲

It costs nothing and involves you in nothing. ▲ ▲ ▲

Better wire at lower cost. ▲ ▲ ▲

We can serve you quickly and economically.
Send in your specifications for a quotation.

"HUDCO"
FINE WIRES

HUDSON WIRE COMPANY

Ossining, N. Y.

Estab. 1902 — Successors ROYLE & AKIN — Estab. 1902

"HUDCO"
FINE WIRES

tact. However with time line contact construction was applied to this type of rope, and results have exceeded expectations, largely owing to the fact that the rope seems to show unexpected flexibility in proportion to the diameter of the wires, which obviously have to be limited to 19 in number, and therefore of fairly large diameter.

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The Wire Ropery

THE manufacture of wire rope is a science which at the first glance seems very simple, but, as is the case with most other sciences, after one has consecrated a life to it, one comes to the conclusion that one has only begun to scratch the surface of the subject.

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ALTHOUGH in a first class rope manufactory all wire is ordered on the basis of an exact specification, although each coil of wire is tested (at both ends) at the wire mill and certificates obtained giving the results of each test; despite all that, on the arrival of the wire, that is in a well-ordered wire ropery, each coil is verified and tested again for tension, torsion, flexion and elongation, and the results entered in a special register, whilst all coils that do not correspond to the standards established are returned to the manufacturer or set aside for inferior work.

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THE first operation in the ropery is to place the coils of wire on the swifts of the winders, where it is wound on bobbins. When the necessary length of wire has been wound, the wire is cut and the bobbin is placed alongside a stranding machine. When enough bobbins have been wound, the bobbins are placed in the stranding machine, the gearing of which has been previously adjusted to give the required lay to the rope. If the strand consists merely of 7 wires, i.e. six round one, or a number of wires in line contact, not exceeding 25, the stranding is done in one operation.

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HOWEVER, for point contact work with more than 7 wires in a strand, the different layers of wire are on economic grounds stranded in separate operations, for instance, a strand of three to seven wires will be passed through the axis tube of another machine and will serve as a center to be covered by a layer of 12 or 19 wires, as has already been indicated earlier in the paper, and so on until the necessary number of layers has been built up.

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YOU will have seen in the works that there are the longtitudinal machines and the basket type of machine; the longitudinal machines are called snake machines, and the basket type—sun-and-planet, from the motion of the bobbins around the axis of the machine. The snake system is

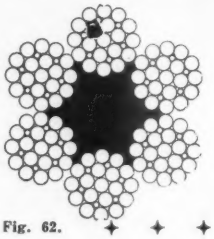

Fig. 62.

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obviously the best owing to its far higher speed and smoother working, but unfortunately the machine has limitations. We have in our works, a 19-bobbin (18″) machine with six supplementary small bobbins which can be used for fine filler wires. This machine extends the whole length of the works and requires three men in attendance. It can be imagined what it would mean to build a snake machine, say, with 37 bobbins of that size, in order to make a 37 wire strand in one operation.

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AT the end of each stranding machine there is a large bobbin called the take-up bobbin, on to which the strand is wound. These bobbins in their turn are taken across to the large sun-and-planet machine, called the closer, on which the strands are closed together around a fibre centre.

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AMONG the many points to be borne in mind in good rope making is that the wire in every process of its manufacture should be well oiled. You will observe that just before the die of each stranding machine there is a can giving a continuous stream of machine oil, whilst the core is soaked for 24 hours in a mixture of vaseline, machine oil and graphite, and the finished rope, after passing through the final die, is covered with vaseline.

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What Constitutes a Good Rope

ROUGHLY speaking a good wire rope, that is to say a rope that can do good under all conditions, does not, and presumably cannot, exist.

However, there are certain standards which can be applied generally in evaluating the quality of wire rope, and they perhaps can be expressed in the one word, homogeniety.

Homogeniety in metallographic structure.

Homogeniety in diameter of wire, etc.

Homogeniety in mechanical tests, e.g. breaking strain, torsion, flexion and elongation.

Homogeniety in diameter of fibre core, etc.

Wire which will correspond to the first three of these standards, whether it be iron wire or acid steel wire with a breaking strain of 200 Kgrs. per sq. mm., can be called good wire.

These are the qualities in which the leading British manufacturers have specialized, and that is why the best British wire has always been, and is today, beyond competition.

Now, let us pass to some details.

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Metallographic Homogenity

CONTROL of the chemical composition of wire, is, of course, beyond the powers of the great majority of wire rope users, but metallographic homogeniety can be controlled by the microscope. For those interested in this point, the following may be helpful.

Eutectoid steel is a steel whose formation is pure pearlite, and has a carbon content of about 0.85%. Steel which has a smaller carbon

content than this will consist of a mixture of pearlite and free ferrite.

Eutectoid steel before being cold worked has a breaking strain of about 82 kgrs. to the sq. mm., say, 50 tons to the square inch. Steel with a less carbon content than 0.85% is metallographically known as hypo-eutectoid, whilst steel with a larger carbon content is known as hyper-eutectoid. Greater carbon content, up to a certain, say, the eutectoid, point of about 0.85%, tends to increase the tensile strength of the steel.

Cold working of steel also serves to raise its tensile strength.

It must be borne in mind that the processes of hammering, hot rolling, and cold drawing, serve to break up the lamellar form of pure pearlite into a more granular structure, metallographically known as sorbite.

From the foregoing it follows that the steel generally used for the manufacture of rope is hypo-eutectoid steel, in other words it has a metallographical structure mainly of granular pearlite or sorbite. The International Association for Testing Materials has laid down a comprehensive definition of sorbite, viz. an uncoagulated conglomerate of indissoluble pearlite. The presence of trootsite or martensite in the structure will indicate that the wire after heating has been cooled too rapidly, and unequal distribution of the structure will indicate that the wire has been subjected to defective hot or cold working. A careful microscopic examination of the wire will elucidate all that is indicated above.

The torsion test however also indicates to a certain extent the degree of metallographic homogeniety. For the standard torsion test one takes a length of wire equal to 100 times the diameter. At such a test 35 twists before the breakage represent a sufficiently homogeneous wire. It is also useful to see whether the spiral made by torsioning is regular. Heterogeneous wire will probably give fewer and irregular torsions.

Homogeniety in Diameter of Wire

THIS can be verified with the aid of a micrometer. Irregularity in diameter will mean additional friction between the wires that go to make up a strand, and it must not be forgotten that this may make a considerable difference in the durability of the rope. It also must not be forgotten that the strength of a wire line is the strength of its weakest spot.

Too little attention in the past has been directed to the self destruction of the rope during work, and to this point the author referred later.

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Homogeniety in Mechanical Tests

THESE tests naturally re-echo largely the degree of homobeniety of the metallographic structure. All of you, who have had to do with constructional work, appreciate that a building made up of parts of different strength is less sound than a structure made exclusively of weaker parts, but of parts of equal strength.

So with the wire rope. It will be found that the best wire ropes are those in which the smallest margins of tolerance in mechanical tests are allowed.

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Homogeniety in Diameter of Fibre Centre

THE fibre centre of a wire rope serves three purposes.

1/. To give pliability to the rope.

2/. To serve as a bed to keep the wire strands in their respective positions.

3/. To serve as a reservoir of oil for lubricating the rope.

It is in regard to the second factor that homogeniety or regularity in diameter plays an important role. An irregular centre means an unbalanced rope and consequently rapid deterioration at specific points.

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Acid Steel Versus Basic Steel

A HIGH breaking strain does not in itself indicate good quality. Generally the most suitable wire for rope purposes is one of medium strength, say something between 80 and 110 tons to the square inch.

It should be borne in mind that a higher breaking strain wire is nearly always harder, and that Acid wire is harder than Basic.

Apart from that, a point to be borne in mind is that the diameter of the pulleys and the speed of work play a very significant role in the matter of the bending stresses to which the wire is subjected, but providing the conditions of work are suitable, Acid wire will practically always give better service.

Acid steel, one might say, is melted direct from pure ore, which contains a minimum, say not exceeding 0.05% of sulphur and 0.05% of phosphorus. Such ores are found in Sweden and in Cumberland, England.

Basic steel is refined from the less pure iron ores, such as are found the world over, by a process of eliminating the excess quantities of phosphorus and sulphur.

Although subjected to all known mechanical tests, Acid wire cannot perhaps be distinguished from Basic wire, but there is no doubt that Acid wire is at least more wear resisting than Basic wire. There are fundamental differences which show themselves in work. In any case, Acid wire undoubtedly resists abrasion much better than Basic wire.

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ALL will remember the consternation recently caused by the collapse during construction of the wire supporting one of America's famous suspension bridges. The wire had passed all the mechanical tests laid down, so no blame could be laid to the wire drawer.

Naturally, samples of the wire reached practically all the high authorities in the world for examination and analysis. Inter alia a part of it went to the University of Sheffield.

A reference is made to this by the Committee appointed to administrate the Department of Cold Working of Steel at the Sheffield University. In their preliminary report they say:

"The difficulty of the subject of the cold working of steel was illustrated by the case of wire used for certain American bridges, which had failed during the construction of the bridge.

"It has been possible to obtain for this laboratory a quantity of the actual wire used. It is found that the material passes all the usual tests quite satisfactorily, and its failure could not be foreseen. This wire has been given the required tensile strength by heat treatment instead of cold working, and although both treatments give good results the wire failed under special conditions, when sharply bent and kept under load. This problem is still under investigation, and a report will be submitted to the committee in due course.

In this regard the following extracts from an article on the Hudson Bridge, written by such an expert as E. E. Thum, are interesting.

"Acid open hearth practice is the only commercial process which can produce the high grade material in the quantities required (28.-500 tons for the Hudson River Bridge)."

He goes on to say:

"Acid steel appears to be more uniform. Now and then basic heat of correct composition fails to develop the required physical properties, for some obscure reason. Acid steel has a higher elastic limit for the same carbon content than Basic steel, and can be successfully put through a drawing program which would be likely to cause many breaks in an equivalent basic steel.

"It is generally admitted that the superior excellence of acid steel is due to its lower content of solid non-metallic inclusions, each one a possible focus of fatigue failure."

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THE only way to be sure of getting Acid wire is to obtain the same from a manufacturer of unimpeachable integrity.

The author went on to summarize some of the factors that affect the flexibility of a wire rope.

The following generally tend to decrease flexibility.

a). Acid Steel Wire
b). Higher breaking strain wire
c). Larger diameter wire, and
d). Point contact construction.

The factors that generally conduce to greater flexibility are:

a). Basic Steel Wire
b). Wire of lower breaking strain
c). Wire of smaller diameter, and
d). Line contact construction.

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FROM this it follows that for small drums and pulleys and fast work, and where there is little demand on the toughness or wear-resistance of the wire, one had perhaps better use Basic wire of low breaking strain, of small diameters, and laid on the line-contact principle. For this reason for bailing ropes basic steel can be used. However, for rotary drilling, where longitudinal and lateral stress are extremely severe, acid steel wire is essential.

Fig. 63.

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BUT it must be borne in mind that in the Petroleum Industry none of the recognised standards are observed in regard to wire rope. Work is conducted at a high speed and on pulleys and drums of far too small diameter. The Petroleum producer should bear in mind that in proportion as the speed of work increases, so the diameter of drums and pulleys should be made larger. With such increase one can use ropes of harder construction and consequently with greater wear-resisting properties and tensile strength.

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AN old system for calculating the diameter of pulleys and drums was about 50 to 80 times the diameter of the rope. Of course this is very vague, as there are millions of sorts of ropes, and furthermore these standards were accepted in the times when ropes were invariably laid on the principle of line-contact.

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A prominent rope engineer, **Mr. T. B. Meals**, of Chicago, has been carrying out a lot of experiments as regards bending stresses on different line-contact ropes, and he has established the following ratios of pulley and drum diameter to rope diameter:

For a 6 x 19 Seale Rope, 28 times the diameter of the rope.

For a 6 x 19 Warrington, 24 times the diameter of the rope.

For a 6 x 25 Filler Contact, 22 times the diameter of the rope.

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Abuse of Wire Rope

THE author remarked that he had been asked to read a paper on wire rope construction and manufacture, but thought it might perhaps not be considered outside the sphere of the paper if before closing, he made a few remarks on the abuse of the wire rope.

Generally speaking, in the oil industry, the ropes are not used at all, they are only abused as is subsequently, in all probability, the rope manufacturer.

Abuses are many, and the author only selected a few.

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Incorrect Coiling

THIS is undoubtedly the most serious offence committed against the wire rope on the oilfields.

The author is referring to the practice of laying the rope in a coil (perhaps a very large coil) on the ground, before winding it on to the drum at the well. Fig. 63 will give you an idea.

Of course the coil is generally a very much larger one than that indicated in the drawing; however, on but a cursory consideration of the action here involved, it will be evident that by dragging this rope from the coil on the ground to the drum in the derrick, an extra twist is being put into the rope for every

coil of the rope as it lies on the ground.

This extra twist in all probability will not take the form of a kink whilst the rope is being wound on to the drum, but what is happening is that a very large number of extra twists will remain in the rope.

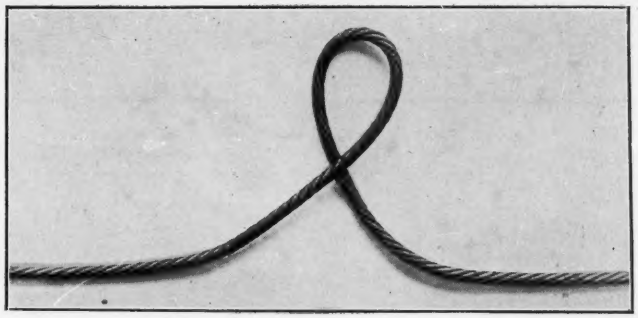

Fig. 64.

The reason that this practice has been allowed to continue to the present is probably due to the fact that formerly ropes in the Roumanian oilfields were used almost exclusively for bailing and percussion drilling.

In the case of the foregoing being done to a bailing rope, in view of the fact that the line hangs free with a bailing bucket at the end, the rope will gradually find its normal position, without any harm being done.

In the case of ropes used for percussion drilling, these are short and held taut. Therefore although the twist could not come out, it also probably could do no harm.

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HOWEVER, nowadays, in the Roumanian Petroleum Industry, ropes are almost exclusively used for the following purposes:

1). Swabbing: The swab being held fairly tight against the well casing, in all probability the rope will not be able to find its normal balance, consequently when the pressure of gas in the well throws the rope up, the rope will have a greater tendency to twist and kink.

2). Pumping: It will be evident that the rope will rotate in the well and in doing so will, from the momentum thus developed, rotate beyond its dead point; thence it will rotate backwards again, and so on till it reaches its normal position. Meanwhile, the result of this rotating mavement may very well be the unscrewing of any parts suspended from the rope, e.g. sinker bars or piston.

3.) Rotary Drilling: Here the danger is greatest of all. The two ends of the rope are kept absolutely fixed; on the other hand there are times during the working of the well when the rope is left without tension for a while. It will then tend to twist as shown in the above drawing. (Fig. 64).

This twist may, or may not, be properly straightened out again when tension is applied. The rope may very likely form a kink or a half kink. Should even a dog-lay be formed in the rope, the lay of the rope may be disturbed, thus creating spots of incipient weakness.

Below is a drawing of such a half kink. (Fig. 65).

No doubt many valuable wells have been lost in Roumania through the breaking of rotary drilling ropes, and it is the author's firm conviction that many breakages have had their origin in the cause above indicated.

Fig. 65.

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Incorrect Drum Width

A point which causes a lot of trouble is the width of the drum not fitting the size of the rope. The result is that after commencing the second layer there are at points spaces between the coils of the first layer, into which the rope can squeeze, pinching and deforming itself. Even when the drum is of the right width, by sheer carelessness this abuse is allowed to happen. A very good method, if the drum is not grooved, is to wind a piece of old rope tightly over the barrel, hammering the ends in, so that the rope remains tightly in place. However, one must be careful not to use rope with jagged pieces of wire sticking out. Otherwise, any old bit of rope can be used for this purpose.

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Corrosion by Acid or Water

ONE would think an oilfield to be a place where rust should not come into the question, and yet in the largest concerns here the author had found, for instance, the reserve drum of a rotary drilling rig holding a rope red from rust. Such rope is obviously half destroyed. Once corrosion enters the rope,, there is little chance of getting rid of it. It spreads like a cancer.

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The Insertion of Material Between The Strands as Signals

THIS is a pretty sure method to get the strands out of position. If such signals are required, then pieces of hemp rope should be tied around the rope.

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The Forcing Loose of Casing That Has Become Fixed in a Well

THIS is a severe strain on a rope. For such it is preferable to use a rope which has already been set by more normal work. In other words, a rope that has already had its first elongation.

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Sudden Striking of the Liquid With The Bailing Bucket or Swab

ON approaching the level of the liquid in the well it is advisable to slacken the speed. A hard blow on the surface of the liquid may produce the opening of the strands of the rope, thus causing the centre to come out. Furthermore, kinks

(*Turn to page 28*)

'Round the World With the Wire Industry

New Aluminum Alloy Industry For Wales

AN enterprise known as the Ayedeecee Metals Parent Co., Ltd., is in process of registration with a capital of £15,000 ($75,000) to exploit a new patent for the manufacture of an aluminum alloy, which is claimed to be a great improvement on any other alloy at present on the market. Preparations for its manufacture have already been made on the site of the old Cyfarthfa Ironworks at Merthyr Tydfil, where buildings have been placed at the free disposal of the promoters for a period of at least three years.

Two furnaces for experimental purposes have been completed and operations began at the end of November, in charge of A. J. Wakelin, one of the patentees. At present it is proposed to float a subsidiary concern for laying down the plant necessary to produce the metal in large quantities and to roll it into sheets or make wire rods, pipes and cars to meet the requirements of industry.

Tests with the alloy have given complete satisfaction, and there are hopes that the market for it, when its merits have become sufficiently known, will lead to the establishment of an industry at Methyr Tydfil giving employment to 1500 people. The new enterprise has been hailed with gratification in the district, where most of the collieries and ironworks are at a standstill.

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Big Cable Tester for Britain

AN exceptionally large cable testing machine has just been constructed by W. & T. Avery, Birmingham, for installation in the Netherton proving-house of Lloyd's British Testing Co. The duty of the machine, which is of nearly 850 tons capacity, is to test cable specimens, etc., up to 15 fathoms. It is of the lever type, having an hydraulic straining mechanism consisting of a main and subsidiary ram for dealing with high and low capacities respectively.

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An Insulation "Singer"

A NOVEL "singeing" apparatus has been perfected in Switzerland to remove insulation from wires, cords, and cables of all kinds—work electricians are frequently called upon to do. Wire-stripping is a delicate operation calling for the exercise of considerable skill; special pliers, knives, and scissors are generally utilized for this work, but there are two important drawbacks to their use, (1) they are apt to damage the wires and (2) they require such skill in handling that, in the hands of any but first-rate-strippers, they are wasteful of time. Thus the singeing machine meets a real need of the electrical industry.

This apparatus is made in two types, one for light and the other for heavier forms of insulation. Both are easily portable. In the case of the former, insulation is burned through instantaneously and almost as though a knife had been run round the cord; the latter singes the insulation both circumferentially and lengthwise.

The equipment is electrically operated and consists in the main of two rods of a special alloy that are kept at red heat by means of a transformer. The rods are so made that they can remove the insulation from two wires or cords simultaneously. When the wire or wires are properly spotted on the lower rod, the upper one is brought down in contact with them by the movement of a lever. There it remains for one or two seconds, until the insulation has been effectually burned through. The duration of this period is timed according to the resistance of the wires. A cooling current of air is passed between the rods and the fingers of the operator to protect them from the heat.

Britain Postpones Duties

AN interesting point in a British Treasury Order, recently issued, is the provision made for the temporary postponement of the United Kingdom duty on copper. The agreements made at the Ottawa Conference provide that the proposed duty on copper may be removed if Empire producers are unable or unwilling to sell copper at world prices and in quantities sufficient to supply the requirements of United Kingdom consumers.

During the past few weeks the copper consumers of Britain and representatives of nearly all the copper producers in the Empire have discussed the position and they have asked the Government to suspend for the time being the duty on copper other than electrolytic copper.

Judging from the signatories to the memorandum of agreement between the users and producers, it looks as if the Government has been successful in covering the bulk of the copper users in the United Kingdom. How the safeguards and provisos will work in practice remains to be seen, but the discussions which preceded the final settlement of outstanding differences have probably done more than the list of resolutions is likely to achieve, for in these matters goodwill and mutual understanding are everything.

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Japan Competing With Germany

THE IWECO is faced, as already reported, with keen competition from the Japanese industry in some markets. The fact that Japan, which shipped from 15 to 20 tons of wire nails monthly to India, last year, and from 30 to 40 tons during the first part of this year, supplied 237 tons in August and 347 tons in September has caused a sensation, capturing the

(*Please turn to page 29*)

Exports and Imports of Wire

Exports of iron and steel wire products in July and August, 1932
(In gross tons)

	October 1932	September 1932	October 1931
Wire rods	1,123	2,313	1,621
Hoops, bands, and strip steel	1,161	1,043	1,891
Plain black or galvanized iron or steel wire	571	491	1,221
Barbed wire and woven wire fencing	1,500	1,367	1,134
Woven wire screen cloth	53	44	54
Wire rope	198	104	189
Insulated iron or steel wire and cable	5	4	35
Other wire and manufactures	109	128	273
Wire nails	365	456	934
Tacks	20	23	50
Other nails, including staples	176	188	237
Bolts, machine screws, nuts, rivets and washers	199	223	328
Total, these 12 classifications	5,470	6,384	7,967

Imports of iron and steel wire and wire products into the United States
(In gross tons)

Concrete reinforcement bars	1,669	1,181	8,872
Hollow bars and drill steel	34	125	
Merchant steel bars	2,114	1,193	
Wire rods	403	862	250
Barbed wire	949	748	513
Round iron and steel wire	150	107	140
Telephone and telegraph wire			14
Flat wire and strip steel	77	88	64
Wire rope and strand	175	143	197
Other wire	109	48	42
Hoops and bands	2,904	3,062	3,106
Nails, tacks and staples	862	762	604
Bolts, nuts and rivets	41	12	67
Total, these 13 classifications	9,487	8,331	3,869

EXPORTS from January through October totaled 56.8 per cent of the 1931 shipments over a corresponding period.

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THE volume of foreign trade showed considerable increase in October with a total of 41,226 tons of iron and steel products were exported.

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THE import trade also registered a substantial gain in October due to greatly increased receipts of pig iron. The principal exports were scrap 10,004 tons; skelp 4,224 tons; galvanized steel sheets 3,904 tons. Tin plate was the month's fourth ite mi npoint of tonnage, exports of which were 1,441 tons under the September total.

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CANADA with a total of 13,720 tons was the leading market in October. Japan came second with 7,272 tons including 1,058 tons of wire rods. The Philippine Islands took 5,960 tons while the exports to China amounted to only 2,092 tons.

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IMPORTS again registered an increase, the chief of which 10,046 was in pig iron. Merchant bars amounted to 921 tons and concrete reinforcing bars amounted to 488 tons.

✦ ✦ ✦

THE principal supplier of iron and steel to the United States in October was the Netherlands with a total of 14,210 tons. Second place went to Belgium with a total of 8,007 tons in which we find included, 1,669 tons of concrete bars, 1,660 tons of merchant bars, and 1,551 tons of hoops.

✦ ✦ ✦

FROM Germany we imported a total of 3,485 tons which included 898 tons of barbed wire and 824 tons of nails. Imports from Canada totaled 3,088 tons; and from France 2,282 tons of hoops and bands.

✦ ✦ ✦

RECEIPTS of card clothing again rose—to 4,893 square feet ($4,326)—with the entire quantity coming from the United Kingdom.

✦ ✦ ✦

WIRE cloth and screening imports further declined to 9,520 square feet of which 4,693 square feet came from Germany, 2,759 square feet from France, and 2,068 square feet from Canada.

✦ ✦ ✦

FOURDRINIER wire imports dropped to 70,138 square feet—30,649 square feet coming from Germany, 26,350 square feet from Austria, 7,064 square feet from Sweden, with the balance coming from France and Czechoslovakia.

✦ ✦ ✦

WIRE fencing and netting imports were smaller—receipts of that galvanized before weaving totaling 1,497,750 square feet of which 1,447,750 square feet came from Germany and 50,000 square feet from Belgium, while the trade in that galvanized after weaving amounted to 969,910 square feet, and included 630,500 square feet from Belgium, 254,810 square feet from Germany and 84,600 square feet from the Netherlands.

✦ ✦ ✦

WIRE heddle imports rose to 2,132,000 units of which 1,930,000 came from France, 150,000 from Belgium and 52,000 from Germany.

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A Review of Recent Wire Patents

No. 1,885,288, MACHINE FOR MAKING CAP SCREW BLANKS, Patented November 1, 1932 by John E. Pracny of Waterbury, Connecticut, assignor to the E. J. Manville Machine Company of Waterbury, Connecticut, a Corporation of Connecticut.

This machine is particularly adapted to transfer stock from between one punch and die into line with another punch and die in a metal-heading machine of the type that has two reciprocating punches and two fixed dies arranged in the same horizontal plane. The machine is designed particularly for accurately presenting the stock in the proper position.

✦ ✦ ✦

No. 1,885,361, CHAIN-LINK WIRE FABRIC, Patented November 1, 1932 by Arthur A. G. Land of Chicago, Illinois.

The inventor provides a chain-link wire fabric composed of strands having zig-zag formation, so formed as to afford interlinked portions extending longitudinally of the fabric in common planes, which portions cooperate like the links of an ordinary chain to take the strain of the longitudinal tensioning. By this construction, the need of auxiliary bars or frame members is eliminated.

✦ ✦ ✦

No. 1,885,818, JOINT FOR CONVEYORS, Patented November 1, 1932 by Frank L. Furbush of Graniteville, Massachusetts, assignor to C. G. Sargent's Sons Corporation of Graniteville, Massachusetts, a Corporation of Massachusetts.

This invention relates to conveyor belts of wire and the object is to provide a joint which will be flexible enough to stand strains which are strong enough to pull two sections apart to a slight extent and to also provide a construction in which the joint will be protected all around against the entrance of lint and fibres. A spring is provided integral with the joint for bringing the parts together to normal position after they have been distorted.

✦ ✦ ✦

No. 1,885,821, WIRE ROPE AND METHOD OF MAKING THE SAME, Patented November 1, 1932 by Richard Duane Green of Trenton, New Jersey, assignor to John A. Roebling's Sons Company of Trenton, New Jersey, a Corporation of New Jersey.

This is described as an improvement upon the present patentee's prior patent 1,777,117 and in this present construction every part of the length of the strand or wire rope has unformed wire present to indicate the rope's condition, instead of having some sections consisting only of wires or strands formed into permanent helices before or in laying them up, which sections would be without wires or strands giving definite indication of the rope's deterioration by the spring out of wires or strands.

✦ ✦ ✦

No. 1,886.026, OPEN-MESH WOVEN WIRE TUBE, Patented November 1, 1932 by Edgar E. Kellems of New York, N. Y., assignor to Kellems Products,

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

Inc., of New York, N. Y., a Corporation of New York.

One of the objects of the invention is to weave the wire tube upon a mandrel of appreciably smaller diameter than that of the object to which it is to be applied so that when placed upon the object it will automatically distend axially and contract radially under its own tension for the purpose of tightening upon the object throughout its length.

✦ ✦ ✦

No. 1.886.194, METHOD AND APPARATUS FOR CHAIN MAKING, Patented November 1, 1932 by Christian Kohm of Providence, Rhode Island, assignor to Edwin F. M. Speidel of Cranston, Rhode Island.

This machine is stated to be particularly adapted for making chains of dumbbell wire. The method consists in forming a piece of channeled wire, bending the ends of the piece of wire upwardly, and wrapping the piece of wire in cylindrical fashion about the adjoining heads of a pair of dumb-bell links.

✦ ✦ ✦

No. 1,886,240, SCREW CUTTING TOOL, Patented November 1, 1932 by John A. Arenz of Mount Vernon, New York, assignor to International Screw Co., of Wilmington, Delaware, a Corporation of Delaware.

In the construction of this tool, the inventor uses a number of adjacent tools which are used to cut a double thread the one screw groove completes the cut arranged that they operate in the same thread, thus the double tool cutting in the one schew groove completes the cut in that groove before starting on the cut of the other groove which forms the double thread screw.

✦ ✦ ✦

No. 1,886,447, APPARATUS FOR MAKING STRANDS AND COVERED WIRES, Patented November 8, 1932 by Edward Slade of New York, N. Y.

It is stated that this apparatus is particularly adapted for the construction of asbestos strands of wire. Copper wire fed into the machine is covered by a number of asbestos strips wound about the wire in such a way that the line of the edges of one of the strips will be out of register with the line of edges of the second covering strip and whereby one of the covering strips envelopes wholly the other.

✦ ✦ ✦

No. 1,886,662, WIRE SHAVING MACHINE, Patented November 8, 1932 by Crosby Field of Brooklyn, New York, assignor to Brillo Manufacturing Company, Inc., a Corporation of New York.

The invention relates to automatic machines for producing metal wool from wire strands. Provision is made in the invention to wrap the wire around a large portion of each rotary bed which ordinarily forms a part of the construction of such a machine, this wrapping occurring substantially in advance of the first knife and it is claimed this results in a much steadier operation of the machine.

✦ ✦ ✦

No. 1,886,663, WIRE CUTTING MACHINE AND TENSION REGULATOR THEREFOR, Patented November 8, 1932 by Crosby Field of Brooklyn, New York, assignor to Brillo Manufacturing Company, Inc., a Corporation of New York.

This invention relates particularly to a tensioning device which operates to keep the end tension on the wire of each wheel closely limited to that necessary to keep only the first and last loop portions of the wire in proper non-slip engagement with the grooves of the machine. This is stated to be important even if the difference in circumference between any two adjacent grooves is slight.

✦ ✦ ✦

No. 1,886,786, ELECTRIC CABLE, Patented November 8, 1932 by Isaac Branthwaite of Passaic, New Jersey, assignor to The Okonite-Callender Cable Company, Incorporated of Paterson, New Jersey, a Corporation of New Jersey.

In this electric cable construction, the inventor provides crepe paper in place of the usual paper used in wire cable construction, claiming that the crepe paper holds more oil than the ordinary paper and the oil is more quickly distributed about the cable. It is also claimed that the stretch which is possible with crepe paper is also desirable in its use in cable construction.

✦ ✦ ✦

No. 1,887,215, SPRING FORMING SULATING COILS, Patented November 8. 1932 by Vincent G. Apple of Dayton, Ohio.

Particularly, the inventor aims to provide a process and apparatus whereby the more or less porous covering of magnet wire may be saturated and coated with a determined layer of suitable insulating material in liquid form and partially dried before it is wound into coils, so that there will no excess of the liquid present which may get on the spool or core upon which the coil is placed.

✦ ✦ ✦

No. 1,887,005, APPARATUS FOR IN- AND ASSEMBLING MACHINE, Patented November 8, 1932 by David T. Owen of Cleveland, Ohio, assignor to The Owen Automatic Spring Machinery Company of Cleveland, Ohio, a corporation of Ohio.

This present apparatus is described as an improvement on the machine shown by applicant in paper Serial No. 346,-306, and in this present apparatus coiled wire springs are produced of uniform length and size, the opposite ends of each spring being connected to the corresponding ends of a second spring as rapidly as the springs are produced. A spring coiling machine is provided with two clipping machines, together with means located between them to handle, control and direct the movement and position of the coiled springs at both ends thereof.

(*Please turn to page 26*)

Eugene F. Phillips Rod Mill

(*Continued from page 8*)

the mill at the same position as the corresponding size round.

✦ ✦ ✦

Coilers

FROM the last mill the finished rod is delivered through tubes to the coilers. Three coilers are provided and the delivery tubes are so arranged that any grooves which may be set up in the mill can deliver to any one of the three coilers.

✦ ✦ ✦

THE coilers themselves are of the revolving pin, plate lifting type. All shafts are mounted in S.K.F. ball bearings. Plate and pins are revolved by a variable speed motor. Finished coils are discharged onto a conveyor by an air operated pusher type unloader. The motion of the unloader actuates limit switches in the coiler motor control circuit, to prevent the possibility of starting the coiler with the plate in the raised position or the unloader in the discharged position.

✦ ✦ ✦

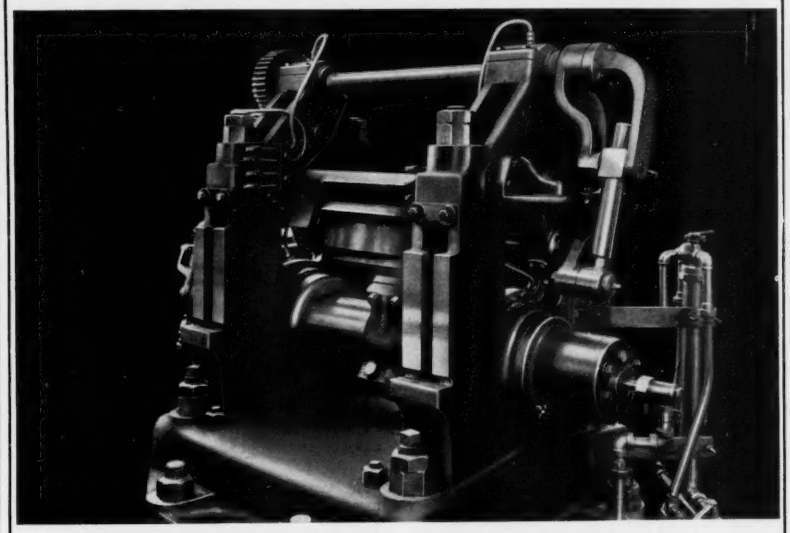
THE coilers and the conveyor onto which the coilers discharge, are controlled from a desk located in front of the coilers. Starting and stopping of the coilers and of the conveyor, and the alignment of any particular groove in the finishing mill with any particular coiler, is controlled by the operator at this desk. The control for the coilers is connected with lights at the finishing mill, so that the man at the finishing mill knows exactly what groove is lined up with an empty coiler.

✦ ✦ ✦

THE conveyor onto which the coils are discharged, is of the drag chain type, special prongs being attached to the chain to move the coil. The frame of the conveyor is of structural steel and has a cooling tank built into it. A constant circulation of water is maintained through this tank for cooling the coils as they pass through.

The conveyor discharges the coils at the far end of the water tank where they are tied ready for pickling and transporting to the wire mill.

FLYING SHEAR *by LEWIS*



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Lubrication of Carboloy Dies

(*Continued from page 13*)

solution is acid, it is not very long before the solution in the wire drawing machines becomes acid also. There are installations, of course, where the wire drawing machines are supplied with wire drawing solution by pumping from a large storage tank, and in these cases, the solution does not usually become acid before the usual period for replacing the drawing solution has elapsed. In these mills, our regular die material is satisfactory. However, there are many using the tub type of continuous wire drawing machine, and here the wire drawing solution becomes acid very quickly. It is under these conditions that we find the tungsten carbide die with the cobalt binder, has not proved satisfactory. The action of the acid solution on the cobalt tungsten carbide mixture in the die, seems to set up small thermocouples, which allow the cobalt to be dissolved, and the tungsten carbide particles to be loosened. The result is that the surface of the die becomes rough in a very short time, scrapes the coating from the wire, plugs up the die opening, and causes the wire to suck down and break. Scratching is also occasioned by this rough surface. To overcome this, we have been using our X-731 grade of metal which is a tungsten-carbide-tantalum carbide mixture. Dies made from this material have proved to be quite satisfactory. Dies made from X-731 material have produced better than 7000 pounds of .028 superpin wire before the die had gone off size at .0284.

✦ ✦ ✦

Effect of Poor Cleaning on Dies

THE difficulties experienced in using Carboloy dies on wet drawn wire, are not all confined to the die material, however. We find that if the processed wire is not thoroughly cleaned before it is coated, a poor coating is formed at the dirty spot, and the coating will rug off in the dies and cause sucking and wire breakage. A good test of the supply wire is to take a white cloth and wipe off the bundle of wire without getting any black smudge on the cloth; a black smudge showing on the cloth means dirty wire, and you will have difficulty in making any dies perform satisfactorily under these conditions, as the coating applied to the wire will not be uniform, and the finished wire will have mottled spots in the bundle, showing that the wire was dirty before coating. We find that pure tin coating has a tendency to rub off with very little pressure, causing the dies to load up and suck. We have been advised by several mill operators that they have overcome this difficulty by adding up to 5% copper in their tin solution. They state that this amount of copper hardens up the coating and makes it cling to the wire much better, and that there is not enough copper present to contaminate the tin pot when the wire is finally tinned. A good way to tell whether the tin coating has enough copper, is to judge by the color of the wire.

✦ ✦ ✦

FURTHER, you will find mills where the wire is coated and drawn a number of drafts on one machine. In these cases it is advisable to give each bundle a coating dip immediately before starting it on the second machine. This practice does away with a great deal of the sucking in the dies which occurs if the wire is not given a light coat immediately before drawing.

✦ ✦ ✦

Conclusion

THIS article has been written with the idea of stressing the importance of a thorough and careful study of the question of lubrication during the wire drawing processes. We believe that a very large proportion of wire mill troubles center here. A very prominent wire mill superintendent told us a short time ago that he estimated that this subject of lubrication carried the answers to 80%-90% of drawing difficulties. We sincerely hope that a spirited discussion of this subject ensues.

PATENTS

(*Continued from page 24*)

No. 1,887,837, CLOSING DIE FOR ROPE MAKING MACHINES, Patented November 15, 1932 by Peter Frank of Wilkes-Barre, Pennsylvania, assignor to American Cable Company, Inc., a Corporation of Delaware.

Among the objects of the invention is the provision of a die, the operation of which is intended to result in the formation of a perfectly round rope having uniform spacing between the component strands, the die being adapted to yield sufficiently to permit passage of a portion of the rope under formation which may be of abnormal diameter.

✦ ✦ ✦

No. 1,888,076, WIRE ROPE AND METHOD OF MANUFACTURE, Patented November 15, 1932 by Martin E. Evans of Pittsburgh, Pennsylvania.

The main object of the invention is the provision of a compact flexible cable in which the outer series of wires of the strands making up the cable has an extended relatively smooth surface. The wire rope or strand comprises a core and a plurality of layers of wire upon the core including an outer layer of Keystone shaped wire resting on an adjacent layer of wire so that two sizes of Keystone wire and the one size of round wire cooperate to form the outer and adjacent layers of wire.

✦ ✦ ✦

No. 1,888,264, LOADED SUBMARINE CABLE, Patented November 22, 1932 by Konrad Goes of Rosrath, and Ernst Badum of Cologne-Mulheim, Germany, assignors to Felten & Guilleaume Carlswerk Actiengesellschaft, Germany.

This invention relates particularly to the filling for the cable, the construction including a conductor with a layer of loading material surrounding the conductor and the filling comprising Hydrocaoutchouc wherein the layer of loading material is embedded.

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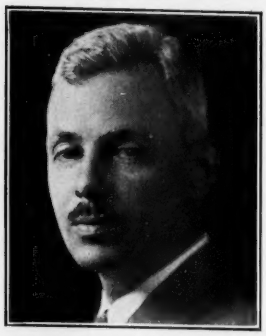
Kenneth B. Lewis to Establish Consulting Practise



KENNETH B. LEWIS

Consulting Wire Mill Engineer, Member Wire Association.

Kenneth B. Lewis, associated for the past twenty-three years with the Morgan Construction Company, has tendered his resignation to that company and will establish a consulting practise in wire mill layout, equipment, and associated problems, with offices in New York and in Worcester, Mass.

✦ ✦ ✦

MR. Lewis is a graduate of Harvard University where he studiel metallurgy under Professor Sauveur. In his early career he spent three years with the Bethlehem Steel Co., chiefly at the open-hearth furnaces, followed by two years of experimental work for the American Steel & Wire Co., at Worcester.

✦ ✦ ✦

HE is probably better known both personally and by reputation than anyone in the industry, his wide acquaintance with men, machines and methods embracing most of the wire producing countries of Europe as well as Mexico, Canada and the United States. It is not too much to say that the present trend toward continuous dry drawing, butt welding and mechanical handling is due in no small measure to his energy and persistence in developing their advantages.

✦ ✦ ✦

MR. Lewis is a member of the board of directors of the Wire Association, of which he was one of the founders, and to whose activities he has given generously of his time and effort. He served as chairman of the steel sessions at this year's meeting. He has been for many years a contributor to the technical press on subjects connected with wire manufacture and has been widely quoted in the foreign press and in books of reference both here and abroad. He collaborated in the compiling of "The A B C of Iron and Steel" handling the chapters on rod and wire manufacture. The historical side of wire technology has been his leading hobby and he has published from time to time the fruits of researches running back through manuscript records of medieval Europe and to the tombs of the Egyptian Kings.

✦ ✦ ✦

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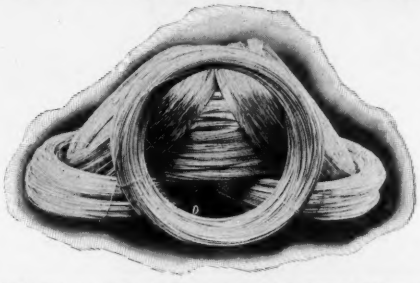

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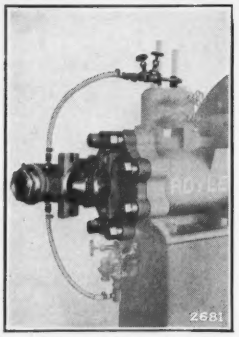
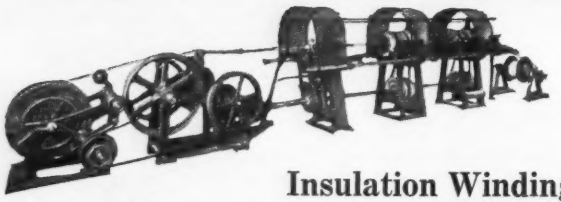


Steam Heated Extruding Head (open) on Royle Tubing Machine



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Technical processes of production are being developed consistently.

To members of the Wire Association an information service is available by which they can obtain data on any subject relating to the industry on which they desire information.

WHY DON'T YOU JOIN THE WIRE ASSOCIATION?

ADDRESS THE SECRETARY,

Richard E. Brown, 17 East 42nd St., New York, N. Y.

The Construction and Manufacture of Wire Rope

(*Continued from page 21*)

may thus be formed in the rope.

✦ ✦ ✦

Sudden application of load to a slack rope.

A rope can very easily be broken in the region of the drum or pulley though clumsy manipulation of the brake.

✦ ✦ ✦

Friction against the sides of the pulley sheaves.

ARISING from improper alignment or too large a fleet angle.

✦ ✦ ✦

Burning of the wires.

MAY arise from slipping of the rope in a clamp.

✦ ✦ ✦

Rope jumping off the drum. Defective Socketing.

IT is not sufficient that the rope should be held tight in the socket. If the tension is not evenly distributed amongst the strands, the result will probably be tight strands, or else strands sunk into the heart of the rope; in other words an unblanced rope and an early collapse.

✦ ✦ ✦

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'Round the World With the Wire Industry

(*Continued from page 22*)

first place as supplier of wire nails to India, and outselling Belgium and Germany.

✦ ✦ ✦

SWEDEN, Hungary and to some extent Poland, all outsiders of the IWECO, are also aiming to get a fair share of the international business, and the fact that the IWECO is on unfriendly terms with some of the smaller export houses causes these merchants to buy as much as possible from outsiders. Under such circumstances the IWECO may be forced to announce competitive prices.

✦ ✦ ✦

THE specialization in the wire mesh industry is making further progress. The German manufacturers have decided to distribute the production of wire mesh, as the wide range of demanded qualities and samples is

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R. E. BROWN, Secretary, The Wire Association
17 E. 42nd St., New York, N. Y.

The undersigned hereby applies for membership in the Wire Association, and agrees to be governed by the Charter and By-Laws of the Society and to further its objects as laid down therein.

Name .....

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Nature of Business .....

making it impossible for small manufacturers to produce first class wire gauze. At the moment this distribution is making satisfactory progress, some manufacturers making mosquito wire gauze, others only mesh for mining and other industries, others only fourdrinier and other special wire gauze, etc. Many of the manufacturers are cooperating and selling through one agent only, so that customers are not compelled to negotiate with the individual manufacturers, when they want to buy mixed specifications.

✦ ✦ ✦

ONE German wire mesh maker has an order worth $41,000 for special wire mesh for breweries from the United States.

✦ ✦ ✦

Italian and Germans Agree on Brass Wire Export Quotas

THE Italian and German brass wire manufacturers have agreed to stop competition in this product in the various markets, and this wire will now be distributed according to the import figures of 1929-1931 (average). They will attempt to extend this agreement to other exporting countries, but with little likelihood of success. The Italian industy is shipping good qualities of brass wire at comparatively low prices.

✦ ✦ ✦

THE efforts to re-establish the collapsed continental-British wood screw cartel have ended unsuccessfully. There will be no cartel as the opposition of the Belgo-French interest is too keen.

✦ ✦ ✦

Continental Nail Exports

THE continental wire nail export business is better. Great Britain which in the months following the imposition of the new import duty, bought only 1000 to 1200 tons monthly is now buying 2000 to 2300 tons monthly. The trade with North America is maintained, but Latin America and the Mediterranean are in the market with rather heavy quantities. Business in barbed wire is very bad, but the demand for wire netting and manufacturer's wire shows a rather satisfactory improvement.

✦ ✦ ✦

German Wire Netting

A LARGE number of German wire netting manufacturers are transforming their production from wire, galvanized after weaving into wire netting made of galvanized wire. The prices for the latter netting are cheaper and it is claimed that the zinc does not chip off as easily from the mesh corners as is the case with the former netting. The trade with the United States is also drifting on a large scale toward netting made of galvanized wires.

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See Furnaces—Various Headings

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National Wrought Iron Annealing Box Co., Washington, Pa.
Scudder, E. J., Fdry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CASTINGS—Wire Mill
E. J. Scudder Foundry & Machine Co., Trenton, N. J.

CHROME NICKEL—Construction
National Wrought Iron Annealing Box Co., Washington, Pa.

CLEANING & PICKLING EQUIPMENT
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COILERS—Sheet and Wire
H. J. Ruesch Machine Co., Newark, N. J.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIES—Composition
Vianney Wire Die Works, New York, N. Y.

DIES—Diamond
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Driver-Harris Co., Harrison, N. J.
Vianney Wire Die Works, New York.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Corp., New York.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Vianney Wire Die Wks., N. Y.

DIES—Recutting and Repolishing Machine
Vianney Wire Die Works, New York, N. Y.

DIES—Rod and Tube Drawing
Carboloy Co., Inc., Newark, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Master Wire Die Co., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Carboloy Co., Inc., Newark, N. J.
Driver-Harris Co., Harrison, N. J.
Master Wire Die Co., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

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H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

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Electric Furnace Co., Salem, O.
W. S. Rockwell Co., New York, N. Y.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
W. S. Rockwell Co., New York, N. Y.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
W. S. Rockwell Co., New York, N. Y.

FURNACES—Electric
Electric Furnace Co., Salem, O.
W. S. Rockwell Co., New York, N. Y.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.
W. S. Rockwell Co., New York, N. Y.

GALVANIZING ENGINEER
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FURNACES—Wire
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W. S. Rockwell Co., New York, N. Y.

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National Wrought Iron Annealing Box Co., Washington, Pa.

INHIBITORS—
Wm. M. Parkin & Co., Pittsburgh, Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—Pulverized
Amer. Lime & Stone Co., Bellefonte, Pa.

LUBRICANTS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thompson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thompson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Machinery Co., Philadelphia, Pa.
Fred'k M. Conran, Newark, N. J.
New England Butt Co., Providence, R. I.
Thompson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Chain Making
Fred'k M. Conran, Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Fred'k M. Conran, Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Const. Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
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H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Insulating
American Insulating Machinery Co., Phila.
New England Butt Co., Providence, R. I.
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Measuring Wire & Cable
New England Butt. Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Panning
American Insulating Machinery Co., Phila.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Lewis F'dry & Machine Co., Pittsburgh, Pa.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
H. L. Reusch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Rubber Strip Covering
John Royle & Sons, Paterson, N. J.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
John Royle & Sons, Paterson, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
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Broden Construction Co., Cleveland, O.
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H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Fred'k M. Conran, Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

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MACHINERY—Stranding
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New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thompson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
Fred'k M. Conran, Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Thompson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Fred'k M. Conran, Newark, N. J.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Micro Products Co., Peoria, Ill.
F. B. Shuster Co., New Haven, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Fred'k M. Conran, Newark, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Thompson-Gibb Electric Welding Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thompson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

PACKING—Metallic Fibre
Hudson Wire Co., Ossining, N. Y.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

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John Robertson Co., Brooklyn, N. Y.

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John Robertson Co., Brooklyn, N. Y.

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ROLLING MILLS—See Machinery—Rolling Mill

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Watson Machine Co., Paterson, N. J.

TANKS—Steel Plate
National Wrought Iron Annealing Box Co., Washington, Pa.

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Vaughn Machinery Co., Cuyahoga Falls, O.

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American Insulating Mach'y Co., Phila., Pa.

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Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Manufacturers
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification
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Seymour Mfg. Co., Seymour, Conn.
Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Steel—Also Coppered Steel—Also Glavanized Steel
Keystone Steel & Wire Co., Peoria, Ill.

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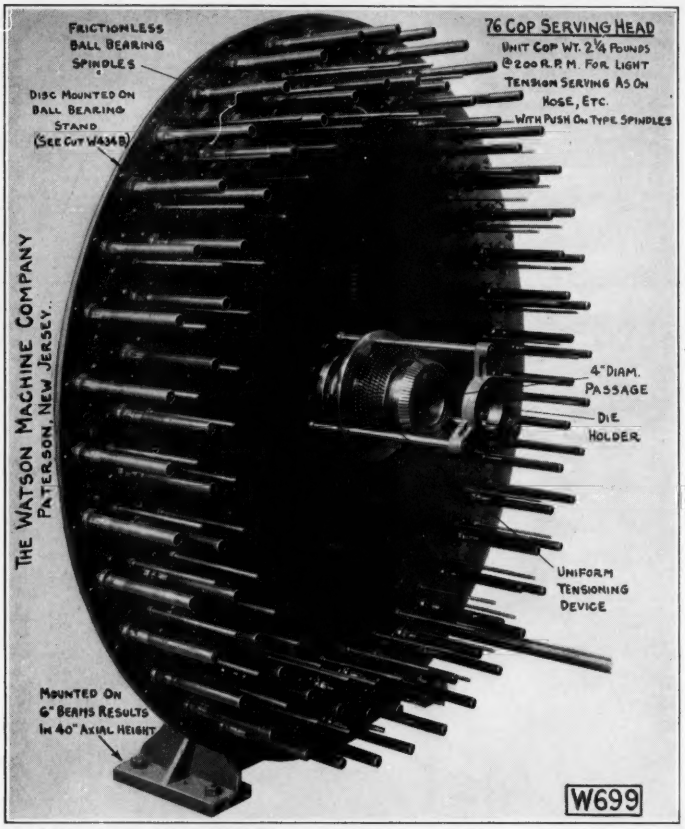
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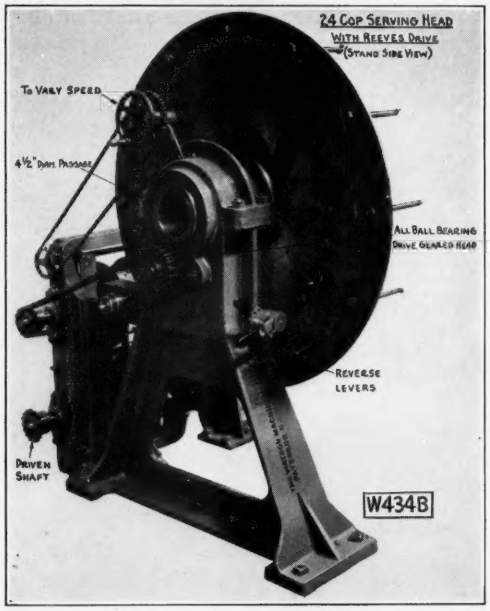

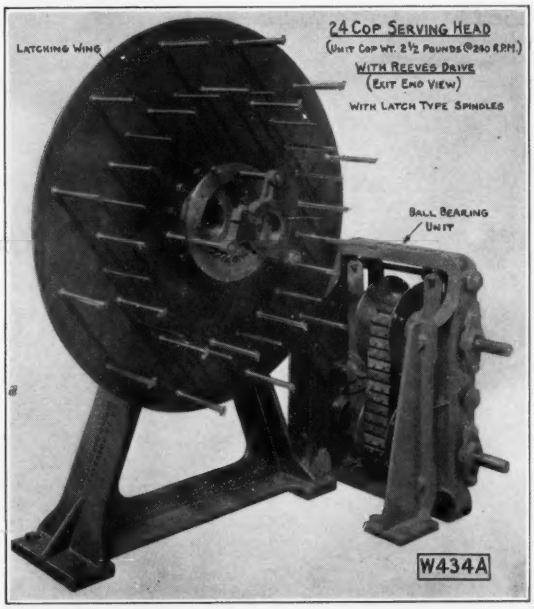

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